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ON THE MINUTE MEASUREMENTS OF MODERN SCIENCE.

By ALFRED M. MAYER.

Article XV.

On the Application of the Rotating Mirror to the Measurements of Minute Lengths, Angles, and Times.

THE HORIZONTAL PENDULUM.

IN this article we will describe the construction and workings of one of the most ingenious, and certainly the most sensitive, of all the measuring instruments ever invented. Heretofore, by means of screws, microscopes, levels and mirrors, we have measured lengths to the hundred thousandths of inches; we now enter into the realm of millionths of inches.

The Horizontal Pendulum, as its name shows, is an instrument which, strange as it at first appears, uses the action of gravity on a peculiarly suspended pendulum as a means of making minute measurements. This instrument, however, has to call in the aid of Saxton's mirror and scale to render its motions precisely measurable, and hence we have brought the horizontal pendulum under the head of instruments which employ the principle of the rotating mirror.

The principle of the torsion balance is also used as an essential part of this instrument in giving a delicate suspension to its pendulum.

Zöllner, a noted German astronomer, of Leipzig, published his description of the horizontal pendulum in *Poggendorff's Annalen* for 1873, vol. 30. At the time he devised this instrument he did not know, what he subsequently discovered, that ten years before it had been invented by a French physicist, M. Perrot. Further search in the records of science revealed the fact that as far back as 1832, a German, named Lorenz Hengler, who subsequently became a Catholic priest, had described the horizontal pendulum in Dingler's *Polytechnisches Journal*, where he gave an account of his observations of the action on it of the moon's attractive force—the very species of observation for which Zöllner had independently devised the instrument.

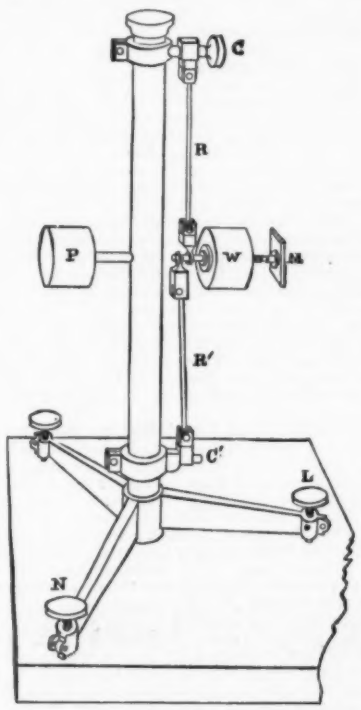
The theory of the action of the horizontal pendulum may be readily apprehended from an experiment that any one can perform with an instrument of very simple construction.

Let R R in Figure 42*a* represent a rigid rod which rotates freely on points at its ends. Attached to the center of this rod is a shorter one carrying the weight W. If the rod R R is horizontal, it is evident that the weight will hang in a vertical position, and if pulled aside from this position will swing to and fro like an ordinary pendulum, till brought to rest by the friction of its pivots and the resistance of the air. This to and fro motion is evidently caused by the action of gravity on the weight and the arm which carries it. Now suppose that we elevate the rod R R till it comes into a vertical position, as shown in Figure 42*b*; then gravity has no *directing* influence on the arm or its weight, for they remain indifferently pointing to any point of the compass to which they may be directed. But if we incline ever so little the rod R R to the vertical, gravity will act on the weight W sufficiently to *direct* the arm and weight A W into the vertical plane passing through the pivots of the rod R R. As gravity acts very feebly in giving direction to the weight, it evidently follows that a feeble force will deflect it from the point of the compass toward which it points; and the more inclined the rod R R is to the vertical the greater must be the force required to deflect the arm and its weight. It follows from the above discussion that if friction is got rid of, the instrument will be susceptible of an extraordinary degree of delicacy, obeying the action upon it of a very feeble attractive or repulsive force.

An instrument which is well adapted to illustrate the above actions on the horizontal pendulum can readily be formed by replacing the short arm and its weight, A W, of Figures 42 *a* and *b*, by a magnet. If to the end of the magnet hanging in a vertical position the similar pole of another magnet be approached, the hanging magnet will be deflected to a certain distance from its vertical position. As we gradually elevate the rod R R we observe the deflection of the magnet A W becoming greater and greater, showing that the directing force of gravity which is opposed to the repulsive action of the magnets becomes gradually weaker and weaker.

We are now prepared to understand Zöllner's instrument, shown in Figure 43. A tripod with leveling screws supports a vertical column, to which are attached two projecting

FIG. 43



ZÖLLNER'S HORIZONTAL PENDULUM

pieces, C, C'. To these are fastened two delicate watch springs, R, R, which support the weight W in the manner shown in the drawing. These watch springs R R replace the rigid rod R R of figure 42, and thus the friction of the pivots of that rod is replaced by the feeble torsion of these delicate steel bands. This torsion acts in concert with the directive action of gravity on the weight W. It is readily seen from an examination of the figure that the weight constantly exerts a pull on each of the springs R R. A counterpoise at P balances the weight of W and its attachments.

Fixed to the front of the weight W is a plane mirror, M. This reflects into a telescope a distant divided scale, as in the manner already described in explaining the Reflecting Comparator of Saxton.

By means of the screw L we render the instrument as sensitive as we wish by approaching to the vertical the line connecting the points of attachment C and C' of the wires R R.

The horizontal pendulum, besides the action of an attractive and repulsive force on W, is affected by another cause. The instrument is very sensistive to a change of level. Thus, if one should turn the screw N of the tripod, ever so little, the weight would move away from the reader, because the vertical plane passing through the points of support C, C' would be shifted in that direction.

We will now describe in order the instrument, first as designed to measure the action of an attractive or repulsive force, and secondly as adapted to measure linear values by the elevation or depression of one of the side legs of its tripod. The instrument was devised by Zöllner for the first purpose, and was so modified by Professor O. N. Rood of Columbia College as to be adapted to the second use.

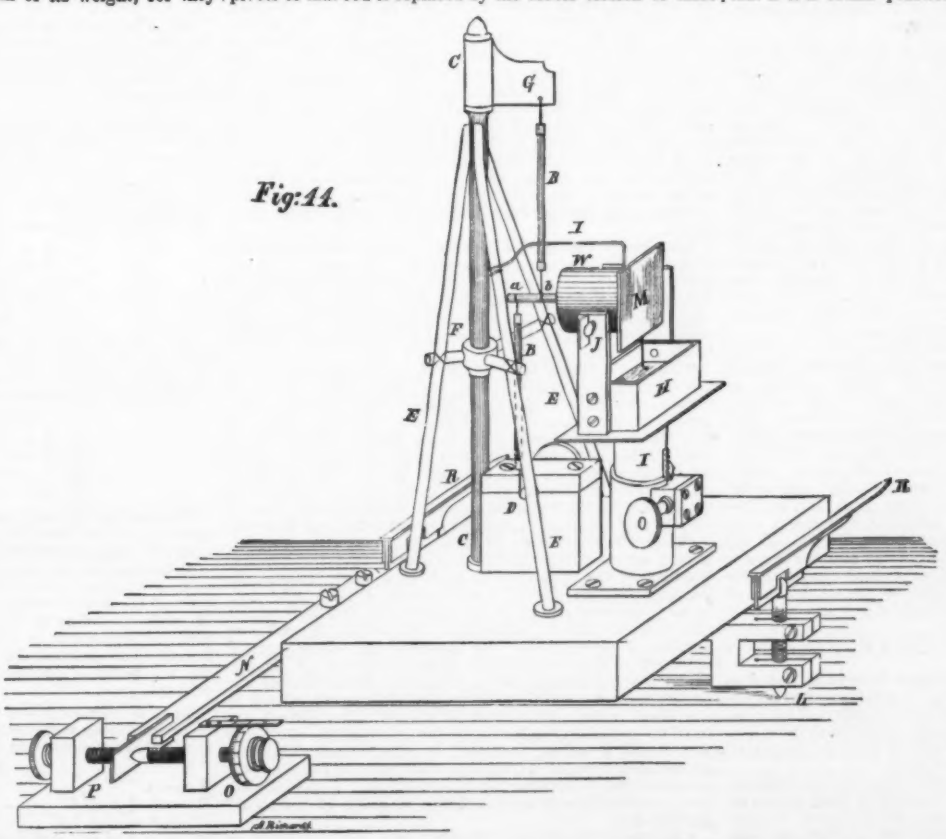
The instrument used by Zöllner was about 20 inches high, and the weight W was of 6 pounds. It was placed on a solid pier like an astronomical instrument, and the motions of its pendulum were observed through a telescope placed outside of the building.

For simplicity of illustration, we will suppose that when the weight is at rest, and the suspending wires R R are without torsion, the mirror M faces the south point of the horizon. In these circumstances when the moon or sun is on the meridian it exerts no action on the pendulum to deflect it to the right or to the left. This position of the pendulum we will call its zero position. But when one of these celestial bodies is to the east of the meridian it pulls the horizontal pendulum in that direction till it comes up to the meridian, and then it is without deflecting action on the instrument. As the luminary goes across the meridian to the west, it draws the horizontal pendulum in the same direction. Zöllner found the instrument so sensitive to these actions that he could obtain, from the observed deflection of the pendulum, approximate values of the masses and distances of the sun and moon expressed in units of the mass and semi-diameter of the earth.

Zöllner ingeniously suggested that this instrument can furnish a measure of at least certain limits to the velocity of the attractive force of gravitation. Since the horizontal pendulum is moved by the attraction of the sun, it can be observed as to the manner it keeps pace with the angular movement of the sun. If the pendulum swings from one side of the meridian to the other with the sun, then the propagation of the force of gravitation is instantaneous, so far as its action on this instrument is concerned. Zöllner says that if it is found practicable to determine accurately the position of the horizontal pendulum when on the meridian to one minute of time, then the velocity of propagation of gravitation can be measured even if it has eight times the rapidity of the transmission of light through celestial space, or 1,480,000 miles per second. This is a beautiful example of how problems which seemed entirely beyond the reach of experiment may all at once receive their solution from the simplest instrumental contrivances.

The above suggestion of Zöllner is so very remarkable that I think it will interest our readers to have his own words before them: "But in addition to all this, the moon and the sun, aside from their producing waves of ebb and flow in the interior of the earth, exert a *direct* influence upon the position of the instrument, since according to their position they attract with varying intensity the center of gravity of the earth and that of the pendulum removed from the former by the distance of the earth's radius. The magnitude of the deflections so produced have been made the subject of an interesting investigation by C. A. F. Peters. The mean deflection which the moon can produce when in a favorable position is, according to the deductions of Peters, 0".0174 (seventeen-thousandths of a second). The deflection of the pendulum caused by the sun's attraction under similar cir-

Fig. 11.

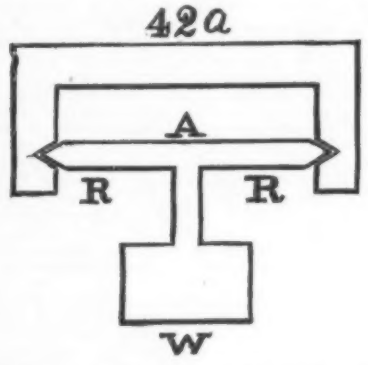


PROF. ROOD'S MODIFICATION OF ZÖLLNER'S HORIZONTAL PENDULUM.

cumstances equals 0".008 (eight thousandths of a second of arc). If, however, the horizontal pendulum, like the one described by me, is so mounted that its position of equilibrium is in the plane of the meridian, then it is plain that the above maximum deflections must have opposite signs according as these heavenly bodies are to the east or west of the meridian, so that the angle which is observed is twice what is given above. That is, the moon will produce a deflection of 0".0348 and the sun of 0".016.

"With respect to the degree of accuracy attained in the above experiments it must be remarked that with a single reading the error would be $\frac{1}{20}$th of the attractive action of the moon to be measured, and $\frac{1}{15}$th of that of the sun. But, as already remarked, the surrounding conditions in making the above observations were altogether unfavorable for the purpose in hand, which showed that the delicacy of the instrument might be considerably increased by placing it in deep mines, with the assumption that the reaction of the heated liquid interior of the earth against the external terrestrial crust does not produce deflections in the pendulum of the same order. There is, therefore, a hope that by collecting an extensive and properly discussed mass of observations to determine those magnitudes upon which the effects just now considered depend; that is, to determine the masses and distances of the sun and moon in units of the mass and semi-diameter of the earth.

"Theoretically there is another interest attached to these observations with the horizontal pendulum. On the supposition that the pendulum has its position of equilibrium in the plane of the meridian, and is moved only under the influence of the sun, it ought to pass its position of equilibrium four times in twenty-four hours; that is, at the rising and setting of the sun and at its upper and lower passages



of the meridian. As these motions of the pendulum would not be motions of summation like those of the ocean, in the case of its ebb and flow, but are produced by direct attractive action from a distance, they must occur *simultaneously* with a corresponding *true* position of the sun. If, however, the force of gravity requires, like light, eight minutes of time to pass from the sun to the earth, then the above-named instants of the positions of equilibrium of the pendulum will be so much belated in time. If then it is possible to determine these positions of equilibrium of the pendulum even only to *one minute of time*, then the question whether the force of gravity requires time for its propagation can be decided even though it have a ratio of propagation eight times faster than that of light."

Zöllner found the tremors of the ground and the changes of temperature affected his apparatus—so delicate is it—and he proposes to place it in a deep mine, where it will be free from these disturbing influences. Thus, strange as it may appear, he will be able, with this instrument, to study under ground the action of the heavenly bodies.

PROFESSOR ROOD'S MODIFICATION OF ZÖLLNER'S HORIZONTAL PENDULUM.

We now come to the consideration of the horizontal pendulum as an instrument suitable for measuring minute lengths. Zöllner found that his pendulum was exceedingly sensitive to a change of level; indeed a change of only $\frac{1}{1000}$th of a second of arc in the level of the base of his instrument tilted the mirror sufficiently to be measurable. The minuteness of this motion to the base of the apparatus may be imagined when we recollect that $\frac{1}{15}$th of a second of arc is the smallest change of inclination that the most delicate spirit level can detect, and some conception of how small an angle $\frac{1}{15}$th of a second is may be reached by considering that if one end of a straight edge one meter long be lifted through the $\frac{1}{2000}$th of a millimeter, or through the $\frac{1}{50000}$th of an inch, this will incline the straight edge $\frac{1}{15}$th of a second to its previous position. Yet Zöllner's pendulum showed a tilt which would equal the lifting one end of the meter through only $\frac{1}{3000000}$th of an inch!

To Professor Rood we owe the first application of the horizontal pendulum to the measurement of minute lengths—or better, to the measurement of minute changes in the dimensions of solid bodies. His paper on this subject, published in the *American Journal of Science* for June, 1875, shows how the tremors and changes of temperature which frustrated the labors of Zöllner may be overcome by means at once simple and effective. Indeed Professor Rood's work was executed in about the worst locality that could have been selected in the city of New York, for, as Professor Rood says, "apart from carriages and street cars, locomotives and trains of cars passed at a distance of 300 feet continuously during most of the day and the greater part of the night." Yet he succeeded in measuring, with his modification of Zöllner's instrument, to the $\frac{1}{3000000}$th of an inch, the smallest linear magnitude which has yet been grasped with compasses of science.

The modifications given by Professor Rood to Zöllner's instrument are shown in Fig. 44.

In Zöllner's instrument the column C owes its freedom from lateral vibrations entirely to its rigidity. But no unbraced column is sufficiently rigid not to be affected by tremors, hence Professor Rood attached to this column three long inclined braces, E, E, E, and connected these to the central column by three short cross-braces F.

At J is shown the head of a screw. Another one similar to it is on the other side of W. To the ends of these screws are fastened spiral springs, which confine the motion of the pendulum within narrow limits. These springs form an essential part of Professor Rood's modification of the horizontal pendulum, for without their aid he often found it impossible to complete the leveling of the instrument, so as to give it even a moderate degree of sensitiveness.

Then Zöllner had no appliance for bringing his pendulum to rest, and indeed in his published observations it appears that it never was at rest; hence he was obliged to take the extremes of the oscillation in order to determine the position of equilibrium of the pendulum. "As this mode of taking readings," says Professor Rood, "was, in my case, owing to the locality and nature of the work, entirely out of the question, it became necessary to supply this defect. Very good results were obtained simply by attaching to the pendulum a wire bent in a series of zigzags, and immersed in a box, H, filled with olive oil. By removing with the pliers successive portions of the wire, it was found that matters could be arranged so that the instrument came to rest after a couple of oscillations. The oil-box rested on a little table provided with rack-work, I, to adjust its height and remove it when necessary. Its dimensions were as follows: length 70 m m., breadth 30 m m., depth 32 m m. The wire was placed of course as near the center of the box as possible, and the effects of capillarity were not sensible."

At I is shown an index or pointer, intended to facilitate the adjustment of the horizontal pendulum with regard to the scale, and readily to bring the mirror into that position in which it reflects the zero or center of the scale into the telescope. It makes a very convenient addition to the instrument. It is observed by a lens placed outside of the glass case which covers the instrument.

The height of the central tubular column is 350 millimeters. The distance from *a* to *b*, the points of suspension of the pendulum W, is 5 millimeters. The distance from *a* to the mirror M is 58 millimeters. The weight of the pendulum with its mirror is 137 grammes.

The apparatus was supported on a well braced and firmly constructed wooden stand, which was hung by its upper end on the brick walls of the college building, and again attached to them below, so as to prevent vibrations independent of the walls of the building itself.

In the first experiments of Professor Rood he used fine steel wires to suspend the pendulum. These he had to discard from their torsion and from the action on them of magnets when he was using the apparatus to study the minute changes produced in the dimensions of iron when it is magnetized. He replaced the steel wires with narrow strips of elastic copper foil, such as is used by jewelers, the ends being soldered to small thin plates of brass to prevent tearing, and these again connected with fine hard-drawn brass wire. The copper foil was adopted merely as a temporary expedient, but as it was found to answer well, and to be free from torsion, it was retained. Experiments were made beforehand on the strength of the bands of foil, and they were loaded to within about two-thirds of their breaking strain.

At D is a milled head for winding up the brass wire attached to the lower copper strip B', and thus bringing the pendulum into such an inclination to the horizon that the scale would be reflected from the mirror into the telescope.

Only one of the leveling screws, that at L, can be shown in the figure. The arm K is connected with this, so that the screw can be turned through a very small angle. The levers attached to the two rear screws are shown, marked R and N. These screws were made of brass, with eighty threads to the inch. These screws rested on plates of brass or glass, which were properly counter-sunk and cemented in a level position on the shelf. They were provided with easily removable lever arms 70 millimeters long. The leveling was always completed by giving gentle taps to these arms, with some light rod, such as a lead-pencil.

The two rear screws, to which the arms R and N are attached, are only distant from each other by two inches. One of these screws rested on the body whose changes in dimension were to be measured. It is evident that if one of these rear screws should be moved up or down, the vertical plane, passing through the points of suspension of the copper bands, would be tilted, and hence the weight and mirror would swing into a new lateral position.

The left-hand screw attached to the arm N served as a micrometer; it rested on a small leveled plate of glass, and the arm N is 140 millimeters long, and is capable of moving over about $\frac{1}{4}$ a degree between the two points of the screws at O and P. To the extremity of the arm N were fastened two threads, one of which went straight to the observer; the other thread passed over a small pulley in its passage to the observer. Thus by these threads one could turn the arm N backward or forward through a known fraction of a degree while the observer was stationed at the distant telescope. The distance traversed by the end of this lever was measured by a compound microscope placed over its extremity; the length of the arm N being known, with the number of threads of the screw to the inch, the actual upward or downward motion of the end of the screw can be very precisely computed.

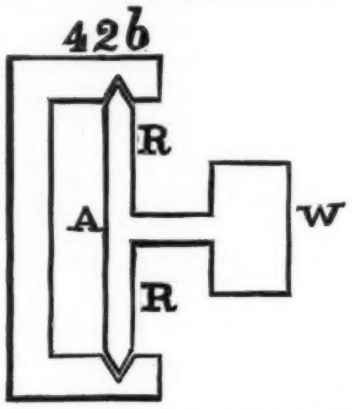
Pointing to the mirror M, at a distance, was a telescope which magnified about sixty diameters. A scale placed under this telescope was reflected into it by the mirror M. This scale was cut on glass. The lines of the scale, when viewed in the telescope, appeared as though about eight millimeters apart, so there was no difficulty in estimating tenths of a division.

"The main difficulties," says Professor Rood, "in making the observations given below, may be divided into two classes, viz., those due to accidental vibrations and those dependent on changes of temperature. The apparatus, as may be imagined, was exceedingly sensitive to vibration, and the locality used by me was in this respect one of the most unfavorable in this country. Hence, in spite of the oil-box, the pendulum was never completely at rest, except for three or four hours after midnight; during the daytime the vibrations were often so rapid as to render the scale divisions invisible. Still, in spite of these disturbing causes, an extended series of experiments has shown that the inherent stability of the apparatus is such that these external influences produce during a moderate interval of time little or no permanent change in the instrument, and their effects can consequently be eliminated by making a sufficient number of observations. To illustrate the delicacy of the apparatus, I may remark that children playing on an iron bridge 360 feet distant caused temporary deflections of one or two divisions, and that similar deviations were caused by the lower notes of an organ in a neighboring church, the medium and higher notes producing no sensible effect. It was found, however, necessary to guard more sedulously against disturbances originating in the building itself, as they were more apt to produce permanent effects." This evil, however, practically only subjected the observer to temporary interruption.

Changes of temperature produce two different kinds of effect on the apparatus. In the first class we may place those which would be compensated by turning the screw L, Fig. 44; in the second, those that would be neutralized by turning either of the other leveling screws. It is evident that changes of the first class alter the sensitiveness of the apparatus or the value of a scale division, but on account of the comparatively large distance between the screws N, R, and K, these effects are small, and may be rendered almost insensible by attention to constancy of temperature; thus far they have not proved a source of annoyance.

The case is different with the second class; the leveling screws, worked by the levers R and N, being separated only by a distance of 50 millimeters, it is necessary, on their account mainly, to preserve the temperature of the apparatus as constant as possible. I shall now consider the method of eliminating errors that are introduced from this source. It is evident that changes of the kind now under consideration will communicate to the pendulum a continuous motion toward the right or left, and will finally drive it to the stops, and that all the readings will be effected with a constant or changing error. If the motion is so slow that the operation of reaching the stops consumes one hour, or even less, it is not a source of serious inconvenience, and the errors thus introduced can easily be eliminated.

General mode of experimenting.—In all cases the micrometer screw (that one moved by the lever N) rests directly or indirectly on the body the change in whose dimensions is the subject of study, and the first proceeding will naturally be to ascertain whether the different portions of the apparatus are at rest relatively to each other, or approximately so. Afterward the value of a scale division can be obtained by repeatedly moving the arms attached to the micrometer screw, by the aid of the threads which reach to the observer seated at the telescope. When this has been satisfactorily accomplished, the body to be experimented on is subjected to the desired influence, and the change in its dimensions noted; for example, the change in the longitudinal dimensions of a bar of iron when magnetized produces with this instrument a large sudden deviation, and it is also possible to note the gradual increase in its dimensions, owing to the heat developed by the act of demagnetization. The instrument as now arranged is applicable to the solution of a great number of delicate problems.



Mode of making and calculating the observations.—The best way of observing, whenever possible, is to make a continuous, connected series of readings, so that the second reading is equally related to the first and third, the third equally to the second and fourth, etc. When this proceeding is used it is possible to obtain correct results, even though the pendulum has an independent motion of its own. To take a simple example, let us suppose that the object required is to determine the value of a scale division, and that by the aid of the micrometer screw a series of continuous readings has been obtained. We have then to consider four principal cases:

1st. *The pendulum had no independent motion of its own.*—In this case it is, of course, a matter of indifference what method is employed in working up the results—*i.e.*, whether the readings are treated in independent pairs or as a continuous series.

2d. *The pendulum has a uniform motion of its own.*—Call the actual readings A, B, A', B', A", B", etc.; let x = the true quantity, and let the motion be positive or tend to increase the readings; d = the distance passed over during the interval from one reading to the next following; let d be positive, and B, B', B", represent the larger readings. We then have for the readings:

$$\begin{aligned} A &= A \\ B &= A + x + d \\ A' &= A + 2d \\ B' &= A + x + 3d \\ A' &= A + 4d \end{aligned}$$

Then as the readings are continuous, subtracting the first from the second, the third from the second, the third from the fourth, the fifth from the fourth, etc., we obtain a set of differences alternately too large and too small, thus:

Differences.	M'
$B - A = x + d$ }	
$B - A' = x - d$ }	x
$B' - A' = x + d$ }	
$B' - A" = x - d$ }	x

The average of each pair of differences will give the true quantity, x, free from errors introduced by motion. In the case now under consideration the average of the column M' will be equal to the average of the column of differences, so that the final result will be identical whether we employ the average of one or the other, but by employing the column M' we have before us the identical observations, free from contaminations due to the independent motion of the pendulum, thus enabling the observer more readily to judge of the reliability of the observations, and to calculate their probable error.

3d. *The distance passed over independently by the pendulum increased during each observation by a constant quantity.*—Retaining the same rotation as before, we have:

	Readings.	
A	$= A$	$= A$
B	$= A + x + d$	$= A + x + d$
A'	$= A + d + 2d$	$= A + 3d$
B'	$= A + x + d + 2d + 3d$	$= A + x + 6d$
A"	$= A + d + 2d + 3d + 4d$	$= A + 10d$
B"	$= A + x + d + 2d + 3d + 4d + 5d$	$= A + x + 15d$

Taking, then, the differences according to the method above indicated, we have:

Differences.	M′	M″	M
$\left\{\begin{matrix} x+d \\ x+2d \end{matrix}\right\}$	$x-\frac{d}{2}$	$x+\frac{d}{2}$	x
$\left\{\begin{matrix} x+3d \\ x+4d \end{matrix}\right\}$	$x-\frac{d}{2}$	$x+\frac{d}{2}$	x
$x+5d$			

The column marked M′ is obtained by taking the average of pairs of differences as indicated by the vinculums on their left hand side; the column M″ by using those on the right; the final column M by combining in pairs the quantities under M′ and M″. It is evident that the final column of means, M, will in this case give the correct value, or x, and that the average of the column of differences will be incorrect by $-\frac{d}{2}$ if an even number of readings be used; and if an odd number be employed, by $+d$, $\frac{3}{2}d$, $\frac{3}{4}d$, $\frac{1}{4}d$, etc.

4th. The distance passed over independently by the pendulum during each observation increases by an increasing quantity. This case may perhaps be most quickly illustrated by a numerical example arranged algebraically, the changes introduced being far larger than ever would be met with in practice.

Let the number, x, equal 30; the first reading equal 25; we then have:

	Readings.
25	= 25
25 + 30	+ 1 = 56
25 + 1 + (1 + 2)	= 29
25 + 30 + 4 + (3 + 3)	= 65
25 + 10 + (6 + 4)	= 45
25 + 30 + 20 + (10 + 5)	= 90
25 + 35 + (15 + 6)	= 81
25 + 30 + 56 + (21 + 7)	= 139

Differences.	M′	M″	M
$\left\{\begin{matrix} 51 \\ 27 \end{matrix}\right\}$	29	31.5	30.25
$\left\{\begin{matrix} 36 \\ 20 \end{matrix}\right\}$	28	32.5	30.25
$\left\{\begin{matrix} 45 \\ 9 \end{matrix}\right\}$	27	33.5	30.25
58			

It is evident in this case that even the final mean will be affected with a small constant error; still for practical purposes this difference from the correct quantity will be far below the unavoidable errors of observation.

As the method with three columns applies to an increasing rate, it is evident that it will apply equally well to one which diminishes, and it hence follows that if the motion decreases till it is zero, and then begins to increase, being affected with the opposite sign, its effects will still be eliminated by the proceeding above described.

I now proceed to give some examples to show the character of the results that can be expected from the horizontal pendulum under very unfavorable circumstance, *i. e.*, when exposed to vibration and changes of temperature. All the observations given below were made in the daytime, the quietest portions being selected, when comparatively few locomotives and trains of cars were passing; no extraordinary precautions with regard to temperature were employed, the pendulum not being inclosed except in its glass case. All the observations are in the form of determinations of the value of a scale division, a proceeding well calculated to illustrate the capabilities of the instrument. The first four constitute a coherent series, the same adjustment of apparatus being used in them all; the others are independent sets made with different adjustments, and intended to illustrate the effects of change of temperature, etc.

Determinations of the value of a scale division.—In No. 1, after using the micrometer-screw, five readings were taken consecutively, the interval between them being only that required for making the record; in Nos. 2 and 3 single readings only were taken, but each reading is to be regarded as a mental average of at least two or three readings; in No. 4 twenty-five consecutive readings were taken on each occasion. The best mode, on the whole, seems to be to take in each case not less than five or more than ten rapid readings, and then again to use the micrometer-screw.

No. 1.

Actual Readings.					Average.	Difference.
54·2	53·2	53			53·4	27·8
81·5	80·9	81·6	80·8		81·2	27·8
53·5	55	53·4	53	52	53·4	29·2
83	82·3	83	83	82	82·6	29·0
56·3	54·2	54	51·6	52	53·6	28·1
82	81	83	81·3	81·5	81·7	29·6
53·2	52·7	51	53·5	50·2	52·1	29·4
80·3	81·3	82·8	82	81·2	81·5	28·2

Although in these observations the temperature seems to have been constant, yet for the sake of uniformity I have prepared to treat them according to the method above described.

M′	M″	M
27·8	28·5	28·15
29·1	28·5	28·80
28·8	29·5	29·15
	Final Average,	28·7

The probable error is 0·198 of one scale division; which, with the adjustment then employed, corresponds to $\frac{1}{1\,7\,5\,0\,0\,0\,0}$th of an English inch.

No. 2.

Actual Readings.	Difference.	M′	M″	M
21	29	28	28·25	28·12
50	27			
23	29·5	29.5	30·25	29·87
52·5	29·5			
23	31	31·75	30·25	31
54	32·5			
21·5	28	26·75	26	26·37
49·5	25·5			
24	26·5	27	27·9	27·45
50·5	27·5			
23	28·4	27·75	28·5	28·12
51·4	27·1			
24·3	29·9	Final Average,		28·48
54·2				

The probable error is 0·461 of a scale division, which corresponds to $\frac{1}{7\,5\,0\,0\,0\,0}$th of an English inch.

No. 3.

Actual Readings.	Difference.	M′	M″	M
68	26	29	30·25	29·62
42	32			
74	28·5	29·25	30·1	29·67
45·5	30			
75·5	30·2	32·2	32·1	32·15
45·3	34·2			
79·5	30	29·55	29·70	29·62
49·5	29·1			
78·6	30·3	29·15	26·9	28·02
48·3	28			
76·3	25·8	28·8	30·9	29·85
50·5	31·8			
82·3	30	30·1	28·85	29·47
52·3	30·2			
82·5	27·5	Final Average,		29·77
55				

The probable error is 0·31 of a scale division, corresponding to $\frac{1}{1\,1\,3\,0\,0\,0\,0}$th of an English inch. It is to be remarked that while these last readings were being taken three heavy trains passed.

No. 4.

Average of 25 Readings.	Difference.	M′	M″	M
75·04	29·54	29·45	29·27	29·36
45·50	29·37			
74·87	29·17	27·93	29·75	28·84
45·70	26·70			
72·40	32·80	Final Average,		29·10
39·60				

The probable error is 0·16 of a scale division, corresponding to $\frac{1}{2\,1\,9\,0\,0\,0\,0}$ of an inch.

Combination of Results, 1, 2, 3 *and* 4.—It is evident that the weights of these results are quite different; accordingly, after taking all things into consideration, I assigned to Nos. 2 and 3 single weights respectively, to No. 1 a double weight, and to No. 4 a threefold weight. Under these conditions the average of the four sets of observations is 28·99, with a probable error of $\frac{1}{10}$th of a scale division, corresponding to $\frac{1}{3\,3\,3\,3\,1\,0\,0\,0}$th of an inch.

In Nos. 1, 2, and in the first four readings of No. 4, there is no decided evidence that the pendulum had any independent motion of its own; in No. 3, its independent motion seems to have been nearly uniform.

I give now a case where the pendulum was affected with a rapid uniform motion: each reading given below is the average of ten rapid readings.

No. 5.

Readings.	Difference.	M′	M″	M
101·5	23·1	33·4	32·3	32·8
78·4	43·7			
122·1	21·0	31·2	31·76	31.48
101·1	41·4			
142·5	22·12	Final Average,		32·14
120·38				

The probable error is 0·44 of a scale division, corresponding to $\frac{1}{2\,3\,6\,0\,0\,0\,0}$th of an inch.

No. 6.

Here each reading is the average of twenty-five rapid readings: the sign of the motion changed during the observations.

Readings.	Difference.	M′	M″	M
92·5	53·36	48·81	47·82	48·31
39·14	44·26			
83·40	51·38	49·72	46·13	47·92
32·02	48·07			
80·09	44·19	48·14	45·35	46·74
35·90	52·10			
88	38·60	Final Average,		47·65
49·40				

The probable error is 0·31 of a scale division, corresponding to $\frac{1}{1\,8\,5\,0\,0\,0\,0}$th of an inch.

When it is recollected that with the best optical and mechanical means it has hitherto been hardly possible to measure quantities smaller than $\frac{1}{2\,0\,0\,0\,0\,0\,0}$th of an English inch, the field which the use of the horizontal pendulum, even under very unfavorable circumstances, opens, will be easily appreciated."

ON THE MEASUREMENT OF CURRENTS.*

By W. H. PREECE, Vice-President, Memb. Inst. C. E., etc.

A UNIT is some fixed or selected magnitude to which all concrete quantities of the same kind can be compared or by which they can be measured. The numerical value of any quantity is its ratio to this unit. The common unit of length is the foot, of mass the pound, and of time the second, but the generally accepted scientific unit of length is the centimeter, of mass the gramme, and of time the second. All true physical units are derived from these fundamental units, and are called absolute.

The proper selection of an absolute system enables scientific men of all nations to bring together all kinds of physical quantities to one common scale of comparison.

It is impossible to overestimate the value to telegraph engineers of the absolute system of electrical measurements. It has brought us all within one fold. However diverse may be the instruments we use, we can comprehend electrical conditions everywhere if properly stated.

The Committee of the British Association, appointed in 1861, which determined the unit resistance and called it an ohm, also determined similar standards for the relative measurement of other electrical quantities, viz., electrical quantity, capacity, potential or electromotive force,† and current strength. No name has been given to the unit of electrical quantity, but the unit of capacity, which is based upon it, has been called a farad. The farad is, in fact, that condenser which contains unit quantity when raised to unit potential. The name of volt was given to the unit of electromotive force, and the name of weber was given to the unit of current. Each of these units has been brought into general use with the exception of the last, and of them all, probably the last is the most important, and is likely to be used as much as any other. In America, where, as a rule, the scientific points of telegraphy have been rather neglected, the use of the weber has been pretty general, and there it is the practice to speak of the strength of currents, either leaving a station or entering a station, as equivalent to so many webers. On several occasions I have been asked, "What is the strength of currents that leave your stations?" and I have been ashamed to acknowledge that I was unable to tell without calculation. Mr. Warren de la Rue suggested that we should always measure the strength of our currents by a voltameter, but a tangent galvanometer, a sine galvanometer, or, indeed, any other practical form of galvanometer, is equally serviceable under the absolute system of measurement.

Now, the unit of current strength, or the weber, is that current which is produced by one volt, acting through one ohm; it is, in fact, the value of C in the equation

$$C = \frac{E}{R},$$

when all three magnitudes are expressed in the absolute system. Whenever we know the value of E in volts and the value of R in ohms, we have got the value of C in webers. It very fortunately happens that the electromotive force of an ordinary Daniell cell is almost exactly the volt—really, for a pure Daniell cell, it is 1·1 volt—so that where we know the number of cells and the resistance of the circuit we have approximately the number of webers flowing. Thus, for example, if the resistance of a line with its instruments be 500 ohms, and we employ a small 10-cell Daniell (whose resistance would be about 200 ohms) to work it, then the current flowing would be

$$C = \frac{10}{500+200} = \cdot 014 \text{ webers.}$$

It, however, happens that inasmuch as the number expressing the resistance of our circuits in ohms is always very much greater than the number expressing the electromotive force in volts, the currents used for telegraphic purposes are invariably less than a weber. Hence it becomes advisable to use a sub-multiple of the weber in the same way that we have a sub-multiple of the farad, viz., the "micro-farad." The same reasons, but in the opposite direction, have introduced a multiple of the ohm, the "meg-ohm," as a measure of the insulation of gutta-percha and other coated wires. The sub-multiple that I suggest is the $\frac{1}{1\,0\,0\,0}$th part of a weber, or a milli-weber. Thus the above current would have been 14 milli-webers.

In indicating these different magnitudes it has been customary to follow the plan adopted in indicating degrees, minutes, and seconds, by giving to the ohm the Greek letter ω, and to the meg-ohm the capital Greek letter Ω. But to the farad—although I suggested some years ago the letter ρ—the same plan has not been adopted. However, I propose now to adopt it, and to indicate the farad by the capital letter Φ, and the micro-farad by the small letter ρ. Similarly with the weber, to which I propose to apply the capital Greek letter Γ, and to the milli-weber the small Greek letter γ, a symbol which is already extensively used in mathematical papers to indicate the strength of currents.

Now, to obtain the value of a current upon a circuit in milli-webers it is only necessary to take a reading on any galvanometer whose resistance is known, and then to reproduce that reading upon a known artificial line. Knowing the electromotive force and the resistance of the battery, the resistance of the line, and the resistance of the galvanometer, we obtain at once the current strength in webers. To obtain milli-webers we have simply to multiply this result by 1,000. Thus, for example, if, with an ordinary galvanometer of 100ω resistance and a 10-cell Daniell of 200ω resistance, employed for working a line, we obtained a certain deflection on the line, and, to reproduce this deflection, we found it necessary to replace the line by a resistance of 500ω, then the strength of the current working the line would be

$$\frac{10}{10+100+500} = 16{\cdot}4\gamma.$$

With a tangent or sine galvanometer the operation is simpler, for we have only to make one observation, either upon a constant or upon a known line, to be able to obtain the "reduction factor," so as to be able to produce the equivalent value for each degree of deflection.

The use of this standard will enable us to form a figure of merit which will represent the sensitiveness of any galvanometer or electro-magnet, for we simply have to find the resistance through which a single cell, or any given number of cells, will actuate a relay, or move a galvanometer needle a given number of degrees, to get a reading which will give us a standard expressing the sensitiveness of the instrument under trial in milli-webers. Thus, for example, if we find that a one-cell Daniell would actuate a relay whose resistance was 500ω, through a resistance of 8,000ω, then the figure of merit of the relay would be:

$$\frac{1}{8{,}000+500} = 118\gamma.$$

The follo—ing indicates the figure of merit of several relays:

	Resistance of Coils.	Marks good through.	Figure of Merit.
No. 1	414ω	22,000ω	·04γ
No. 2	608ω	18,000ω	·05γ
No. 3	303ω	10,000ω	·09γ
No. 4	696ω	22,000ω	·04γ

This method also enables us to conceive a very clear idea of the condition of a line during various changes of weather. Thus, while on a fine day both the sending and receiving currents at each end of the line were equal, and about 6·5γ, on a wet day the sending current became 20γ and the receiving currents only 3γ. If the strength of current in milli-webers were recorded at several stations along a line, it would be possible to plot out in a curve the condition of insulation along its whole length.

* Paper read before the Society of Telegraph Engineers.

† Electromotive force is difference of potential, and when earth is used for one point potential and electromotive force are synonymous.

EFFECT OF THE TELEPHONE ON FROGS.—At a recent meeting of the Medical and Physical Society, Würzburg, Professor Fick exhibited the action of telephonic sounds on the muscles of frogs. The two ends of the telephone wires are placed in contact with the leg muscles of the frog, and the operator speaks into the telephone. The production of the sounds *a*, *e*, *i* has scarcely any raneic effect; while *o*, and especially *u*, produce a most violent convulsion, although spoken much more faintly than the *a*, *e*, *i* sounds. The pronunciation of the word "*Zucker*," even in a low tone, causes the preparation to jump, while the very loudly-spoken command, "*liege still*," has a scarcely sensible effect.

THE TELEPHONE IN GERMANY.

THE *Archives of Posts and Telegraphs*, published by the German Postal Administration, in its issue for December, 1877, gives an account of the experiments made with the telephone or "Fernsprecher" (Far-speaker), as Dr. Stephan, the Postmaster-General, has christened it, and its introduction into the regular telegraph service of Germany.

It refers to an article in a previous number, in which an account was given of the experiments made with the telephone in America, Great Britain and Germany, and the conviction therein expressed that the German Telegraph Administration would bring the apparatus into general and practical use. This, it says, thanks to the continued and successful exertions and experiments made under the personal direction of the Postmaster-General, has been accomplished.

"Germany," it says, "which, through the invention of Philip Reis, had given the first impetus to telephony, is—owing to the unprecedentedly rapid perfection which the practical use of the apparatus (improved in America) has undergone in our land as a means of communication—the first country in which the 'Far-speaker' has been introduced in the official service of any telegraph administration."

The general interest in the new instrument of communication has been aroused in a manner previously unknown in the history of invention, and continues to increase, as is shown by the prominence given to it in every journal, and by private communications from every part of Germany.

In consideration of the importance of the "Far-speaker" to intercourse and civilization, it records the experiments made with it from the first theoretical experiment to its practical application in the telegraph service of the country.

The first notice of the speaking telephone which attracted official attention was through the SCIENTIFIC AMERICAN for October 6, 1877. The Chief Telegraph Official immediately wrote to Mr. George B. Prescott, the well-known electrician of the Western Union Telegraph Company at New York, requesting him to forward drawings of the apparatus as recorded at the United States Patent Office. Before a reply could be received, however, Mr. Fischer, manager of the main telegraph office, London, who happened to be in Berlin in the month of October, presented the Postmaster-General with two Bell's telephones. With these experiments were made October 25th, in the main office at the General Telegraph Headquarters. On the 26th of October they were tried between the central office of the Postmaster-General and the main telegraph office, a distance of 1¼ mile. These experiments were continued with favorable results, the distance being gradually increased. On October 30th the apparatus was tried between Berlin and Schonberg, 3¾ miles; Berlin and Potsdam, 16 miles; and Berlin and Brandenburg, 37 miles. When the distance was increased to 93 miles (between Berlin and Magdeburg), on October 31st, the result was not as satisfactory. The words did not come perfectly, although when the voice was much raised, a few disconnected words, such as "General, Christiani," etc., could be understood.

On November 3d, on the occasion of the cable festival at Kiel, experiments were made with two telephones from the factory of Messrs. Siemen & Halske at Berlin, constructed according to an original telephone imported from America. These experiments were on the 4th continued in the main post-office at Kiel.

November 5th, the first permanent introduction of the telephone was made between the offices of the Postmaster-General and the Director-General of Telegraphs.

November 9th, the Postmaster-General made his official report to the Imperial Chancellor, Prince Bismarck, with regard to the new invention, and on the 10th a telegraphic order was received from his Highness to construct a telephone circuit in Varzin.

On the 12th experiments were made at Varzin by three postal and telegraph officials sent there for the purpose under the personal direction of Prince Bismarck, with satisfactory results.

On the 12th November, also, the first "Far-speaker" office for public use was opened in Fredericksburg, near Berlin.

On the 19th an order was issued for adopting officially the German name, "Fernsprecher," for the invention.

On the same day orders were given to open a number of "Far-speaker" offices in the Potsdam, Halle, Magdeburg and Stettin districts, and subsequently in the Berlin district.

A more rapid progress was delayed on account of the slow delivery of the "Far-speakers" ordered.

Nov. 21st the original model of Reis's telephone was acquired by the Telegraph Administration, having been discovered in Frankfort by the mechanic Albert.

On the 25th of November experiments were made in the presence of His Majesty, the Emperor, at his palace.

By official decree, November 28th, 1877, regulating the service on telegraph lines by means of "Far-speakers," the introduction of the telephone in the practical telegraph service of the German Empire has been formally accomplished; and the passing of the telephone into practical use may be regarded as satisfactorily completed.

WHAT NEXT?

By BISHOP CLARK, of Rhode Island.

IT seems as if it were only yesterday that we heard the booming of the guns, proclaiming that a message had been transmitted across the Atlantic on the bed of the ocean. It is less than a century since Galvani operated with his frog's legs on the plain little desk in the University of Bologna—where I had the privilege of standing just a year ago, on the very spot that his feet occupied when he revealed the wonders of that great science which has ever since gone by his name. It is but a little more than a century ago that Franklin sent up his silk kite into the clouds and brought down the lightning, showing that it was identical with electricity. It is but a few years since the first intelligence was flashed across the wires from Washington to Baltimore—an era in the history of the world.

And now what do we see? The telephone gradually superseding the telegraph—the voice taking the place of writing. Manufacturers stretch a little wire from their counting-rooms in the city out into the country where their mills are run, and talk with their clerks as readily as if they were all in the same room. Miners away down in the bowels of the earth put the tube to their mouth and tell their friends up in the office when the fire-damp is beginning to gather, or the supports to crack, or the waters to break out. Divers take the wire with them down into the bottom of the sea, and as they ramble over the old wreck—what an experience this must be!—inform their associates overhead what is the state of things down there among the fishes and water-snakes and torn cordage and broken planks, and direct them what to do. The orchestra plays in one city, and is listened to in another. The only trouble with the over-sensitive telephone is that it picks up and carries with it everything that is going on in the vicinity of the wire, so that sometimes the message forwarded may be drowned out by the conflicting noises of the natural world; or perhaps the confidential words addressed to one particular ear may be blurted out in the hearing of others.

But when the invention of Mr. Bell's telephone was announced to us the other day, who could have dreamed that close upon its heels would follow the "talking phonograph?" And what is the phonograph? A little contrivance that may be put into a candle-box and sent off by express to your friends in a distant part of the world, and then made to tell them just what you have spoken into the mouth or rather the ear of the machine. It may not be opened for fifty years, but it will then repeat with the same accuracy every word that you have said, in the same tone and with the same accent. The editor of the SCIENTIFIC AMERICAN says: "Mr. Thomas A. Edison recently came into our office, placed a little machine on our desk, turned a crank, and the machine inquired as to our health, asked how we liked the phonograph, informed us that *it* was very well, and bid us a cordial good night. These remarks were not only perfectly audible to ourselves, but to a dozen or more persons gathered around." In closing he adds: "We have already pointed out the startling possibility of the voices of the dead being reheard through this device, and there is no doubt that its capabilities are fully equal to other results just as astonishing. When it becomes possible, as it doubtless will, to magnify the sound, the voices of such singers as Parepa and Titiens will not die with them, but will remain as long as the metal in which they may be embodied will last. The witness in court will find his own testimony, repeated by machine, confronting him on cross-examination—the testator will repeat his last will and testament into the machine, so that it will be reproduced in a way that will leave no question as to his devising capacity or sanity. It is already possible, by ingenious optical contrivances, to throw stereoscopic photographs of people on screens in full view of the audience. Add the talking phonograph to counterfeit their voices, and it would be difficult to carry the illusion of real presence much further."

The scientific journals will tell you how all this is done, and what a thought it is—*sounds* made imperishable!

What next? Three years ago I published an article in the *Ledger* on *Rubbish*, in which I undertook to show how all sorts of waste material had been utilized in our day. The article is now altogether behind the times. A company is at this moment being formed in Paris for using the sweepings of the sidewalks and the streets. "There is nothing new in that, and these street-sweepings have not proved to be very good fertilizers after all." But it is not for any such purpose that this movement has been started—strange to say, it is for the manufacture of glue and iron. The thing has already been tested, and the dust of the sidewalks is found to abound in particles of leather, worn off from the soles of shoes, that furnish glue; and the dust of the streets, in particles of iron, from the wear of horseshoes, enough to pay the cost of manipulation. The next thing may be to concentrate the grateful odors that come from the kitchens and restaurants and reconvert them into soups and other culinary preparations.

What next? Water-power has long been used as a motor. A manufacturer told me the other day that it gave him great concern to think how much of this valuable source of wealth ran to waste over the dam during the hours of night. I do not know what he can do about it, for water will run when there is nothing else for it to do. A friend from California tells me some wonderful stories about the uses to which water is applied in that land of silver and gold. During the wet season, immense bodies of water accumulate on the high table-lands of the mountains. This is now collected in reservoirs, and conducted by perpendicular pipes to a level, five hundred feet or more below. The pressure of such a height of water, confined in a tube, is tremendous. Of course, if it were let in at the top, without finding immediate vent below, it would burst any pipe that man could make. Attached to the bottom of the tube is a nozzle that can be moved freely, and when the stream that it discharges is directed toward a hill, rich in gold and silver ore, it requires but a few minutes to reduce the whole mass to a state of pulp—great trees are uprooted, huge bowlders of rock fly off into the air—every obstruction vanishes like smoke before the irresistible power of this stream of water, and it will go for hundreds of yards with out a break. The New York Post Office would crumble like sand under such an attack like this. As my friend stood by the water, when it issued from the nozzle, he was asked to plunge his hand into the stream, but he could no more indent it than he could a block of marble; and he says that the only sensation he had was that of heat from the friction of the water. It was then suggested to him that perhaps he might cleave the stream with a good stout ax, but it was like steel striking steel, and before he knew it the ax was sent whirling off to a distance of several feet.

And now *what next?* An Englishman has invented a plan for *suspending* our street-cars from a stout iron-wire and propelling them by electricity. He has just gone home from America to test his experiment.

A thoroughly scientific man says that we shall soon have a style of phonographic writing that will save three-quarters of the time and trouble now involved in ordinary writing and printing. I hope that it will come into use before I have done contributing to the *Ledger*.

One thing further we wait for, and that is a general distribution of the papers through air-tubes, such as are now used, to some extent, in connection with the post-office. If all the readers of the *Ledger* could get the paper on the same day that it is issued, they would have the comfort of knowing that the scientific information conveyed to them through its columns had not already been superseded by something still newer.—*New York Ledger.*

LIGHTING BY ELECTRICITY.

SOME few years since much attention was directed to the Gramme machine for the economic generation of electricity, but like many new inventions it was brought forward in a very crude and incomplete form, the natural result being that it was not successful, and, worse than that, it was very generally condemned as impracticable and a failure; it was adopted by the Post Office authorities for horological purposes, and abandoned, and the success elsewhere was scarcely greater. Yet it appears that the invention was not without merit, for it has since been perfected, and is now being successfully introduced in this country by Messrs. Charles Ball & Co., of New Bridge street, London, who have already several of the machines in operation. It is claimed that lighting by electricity as effected by the Gramme machine and plant has now been reduced to an absolutely practical fact. The plant employed is a magneto-electric machine, an electric lamp, conductor wires and accessories, carbon-points, and a lantern to disseminate the light produced. Motive-power can be obtained from any shaft conveniently at hand in the works, but when these are not available special engines may be used. The experiments made at the works of Messrs. Edmundson & Co., Capel street, Dublin, were remarkably successful. Every minute object on the floor or benches at the far end of the large space covered by the factory was rendered distinctly visible. A few gas jets left burning appeared in comparison almost destitute of brightness, while the different shades or colors of some ribbons, otherwise only perceptible by daylight, were readily distinguishable.

In stating the power of the light, Messrs. Ball & Co. have wisely avoided the exaggeration too common with regard to lights of this character. They explain that the light given by one lamp is absolutely equal to that of 500 gas burners, but that it cannot replace more than sixty or eighty of them on account of the light being concentrated in one point. They say, however, that it will be found sufficient for about 300 square yards of weaving sheds, 600 square yards of engineering works, and 2,000 to 3,000 square yards of open spaces, such as yards, shunting platforms, etc. At the French Great Northern Goods Depot, at Paris, four of the so-called A machines have been working over a year under the superintendence of a single stoker, who attends to a portable engine which drives them. This machine is extremely compact, works easily, and is free from stoppages, heating, or any other cause of trouble. It runs at 850 to 950 revolutions, the pulley being 6 in. in diameter. It produces an amount of light equal to 500 gas burners of 10 candles each. In practice one lamp will replace (say) 70 gas burners, but about seven times the amount of light will be given, and not only so, but the light is brighter and more pleasant, more work is accomplished, and it is of better quality. The total cost of the machine is about £100, and the lamps, lantern accessories, carbons and conductors come to about £50 more.

A curious circumstance is mentioned in connection with the machines. A machine yielding 6,000 candle power requires 2½ horse power to work it, and a 25,000 candle machine requires 8 horse power to work it, but it is stated that although these are the powers required really to work the machine, the power required at starting is about double, as during the first few seconds a large amount of power is absorbed in some particular way which is not yet quite clear. If, therefore, a special engine be used for driving any of these machines it ought to be about double the power named, and as it is most essential that the speed should be regular it is useless to attempt to work the machines with any engine that has not a good governor. The invention now promises to be really valuable.—*Mining Journal.*

RUSSIAN SCIENTIFIC NEWS.

By S. KERN, M. E., St. Petersburg.

The Electric Candle.—The excellent invention of M. Jablochkoff was recently illustrated in a lecture on electric light by Mr. Tchikaleff, in the Russian Technical Society. It appears that the electric candle, in order to be properly managed, requires magneto-electric machines, with a changeable current, which are far dearer than machines with constant current. A candle 0·12 meter long will burn 30 minutes, giving a light equal to 250 candles (normal), and costs 50 centimes, so that a light of 1,000 candles during one hour costs 4 francs, besides the cost of working the machine. In using an ordinary regulator the same intensity of light may be obtained by burning 0·1 meter of coke-stick, which costs 2½ centimes. The lighting of the Palais d'Industrie in Paris by Jablochkoff's candles would cost 600,000 francs, instead of 50,000 francs, the cost of the ordinary regulator arrangement for the same purpose. However ingenious is this invention, there is much yet to be done in order to adapt this system for practical use.

Palladium.—M. Gesechus is engaged in some experiments on the action of hydrogen on the coefficients of elasticity of palladium, and of the alloys of silver and gold with palladium. The experiments proved that the coefficients of elasticity diminish during the absorption of the hydrogen by the wires; the strongest effect was remarked during the use of palladio-silver wires (75 per cent. of Pd, 25 per cent. of Ag). Before and after the evolution of hydrogen the coefficients of elasticity were remarked to be the same.

Light of the Moon.—Prof. Petrouchevsky is in the course of studying the moon photometrically. Several instruments devised by him are nearly ready. As a unit of light in his researches the Professor desires to use the light of the full moon; in using such a unit, and comparing the light of different places on the moon with the light of the area of the moon, the changes in lucidity of our own atmosphere will have no serious action on the photometric observations. During the phases he will use Zollner's comparative tables. The apparatus of Prof. Petrouchevsky differs much from the apparatus of M. Vogel, used by him during his last elaborated researches on the absorption of light by the solar atmosphere.

The Bell Telephone is here also the great attraction of the day. Several firms are now selling this instrument, but the price is rather too high (£1). The simplicity of this ingenious invention is indeed astonishing.

The Electric Pen.—The diffusion of another very useful American invention, the "electric pen," which is well known in England, is much checked by government regulations, as the use of printing implements for private use is strictly forbidden in this country.—*Chemical News.*

ELECTRIC ENGRAVING ON GLASS.—A short time ago, M. Gaston Planté, in causing a powerful electric current to enter a voltameter by means of a platinum electrode in a glass tube, observed that the glass was deeply corroded by the discharge. Following up this discovery, M. Planté has now communicated to the French Academy of Sciences a process of engraving on glass and crystal by means of electricity. The process consists in covering the plate to be engraved with a concentrated solution of nitrate of potash, put in connection with one of the poles of the battery, and in tracing out the design with a fine platinum point connected to the other pole. The battery employed by M. Planté was composed of fifty or sixty secondary elements. Round articles can be engraved by adding gum to make it adhere.

PROFESSOR S. N. CARVALHO'S NEW SYSTEM OF SUPERHEATING STEAM.

THE fact that we are this day discharging into the atmosphere through the chimneys of steam boilers, either from imperfect combustion or defective methods of absorption and transfer to the water, from 20 to 50 per cent of the calorific value of the fuel, and in exceptional cases, where a forced blast is resorted to for the purpose of gaining large capacity from a comparatively small boiler, as high as "70 per cent of the actual heat value of the fuel" is almost a reproach upon the engineering intelligence of the age.

The inventor claims that his new superheating system, if applied to these boilers (which he says can be done at a small cost), will remedy this great waste by recovering fully 25 per cent of the actual product of the coal and converting it into useful heat in the boiler and increased energy and power in the cylinder of the engine.

This heat is employed to superheat the steam and subsequently to raise the temperature of the feed water. In the majority of boilers the inventor finds the temperature of the escaping gases high enough for his purpose, but in some cases he places absorbing pipes in a hotter portion of the gas passages, with, he claims, economic effect, even if heat is appropriated which would otherwise be transferred in evaporating steam directly in the boiler. The inventor depends upon the principle that, if steam entering the cylinder can be supplied with heat additional to that required for its existence as true dry saturated steam, just sufficient to furnish the heat units transmitted into work, and to compensate for the heat which would be abstracted by contact with the cylinder from saturated steam, and if this addition of heat can be rendered capable of control, so as to leave the steam exhausted at the end of the stroke at saturation for the temperature and pressure obtaining at the opening of the exhaust, the best and most economical conditions of its use in other side. This the inventor considers brings the superheating surface under precisely the same conditions as the ordinary water heating surfaces of a boiler, and renders them in nowise less durable. The apparatus was used at the last fair of the American Institute in connection with the boilers that supplied steam to the machinery exhibited, and received commendatory testimonials and a medal. The inventor also submits a report of calorimeter tests, which credits a pound of steam superheated by his apparatus with an average mean of 65 units of heat more than is stated to exist in a pound of ordinary steam.

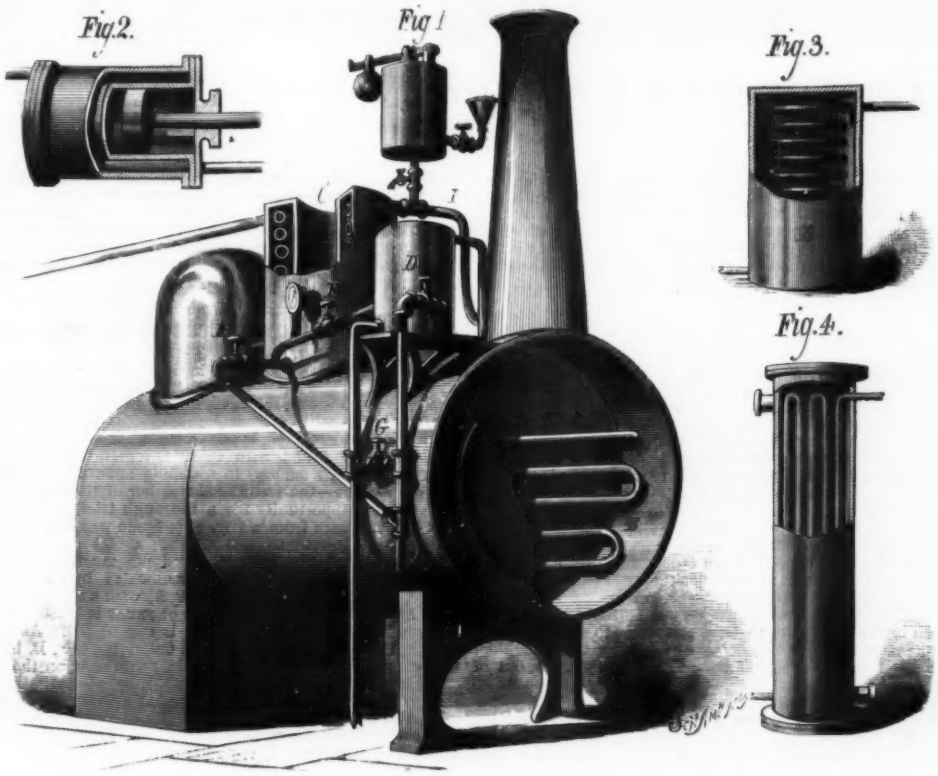
For further particulars address Professor S. N. Carvalho, 65 East 127th St., or 119 Liberty St., New York city.

STEEL ARMOR PLATES.

SOME important experiments were made on board the Nettle target-ship at Portsmouth, for the purpose of testing the powers of resistance of steel and compound steel-and-iron armor plates. Messrs. Cammell & Co., of Sheffield, were commissioned by the Admiralty to conduct a series of experiments, the result of which was the production of three of the four plates which were tested. No. 1 was a solid steel plate, low in carbon, and treated in its manufacture so as to diminish the risk of "starring," which seems to be a defect inseparable from all ordinary steel plates hitherto operated upon. This plate was intended to offer a greater resistance to penetration than the iron plate, and not to star under impact. It measured 9 feet 9 inches by 7 feet 9 inches, and weighed 12 tons 3 cwt. No. 2 plate was composed of hard steel, welded by fusion on to iron by a process patented by Mr. Alexander Wilson, of Sheffield, who was formerly with Messrs. Cammell & Co. It is intended to resist penetration by breaking up the projectile on its striking the plate. In these circumstances it was expected that the steel or outer surface of the plate would undoubtedly crack or star, in consequence of the hardness of the steel; but the idea is that the ductility of the iron at the back will arrest the cracks and prevent their extension through the whole thickness of the armor, and that the vessel will continue water-tight at the same time that the plate itself will remain a protection against the gun. The dimensions are 9 feet 9 inches by 7 feet 1½ inch, the total thickness of 9 inches being made up of 5 inches of steel (at the front) and 4 inches of iron. It weighed 11 tons 4 cwt. The third plate was also composed of hard steel and iron manufactured by the same process as the one preceding, the only difference being that the steel is fused between two layers of iron. This plate is intended to resist penetration and not to start under the blow of projectiles, the thickness of the iron at the back being reduced to a minimum for the purpose of discovering how little iron is necessary for the support of the steel. It measured 8 feet long by 5 feet 11 inches wide, and had a thickness of 9 inches, the front layer of iron being ¼ inch, the back layer 1¾ inch, and the intervening sandwich of steel 6¾ inches. Its weight was about 7 tons 16 cwt. In addition to the three plates submitted by Messrs. Cammell & Co., a fourth had been received for trial from Sir Joseph Whitworth about eight days previously, and had only been fixed in position the night before the firing. It was the smallest of the series, measuring 6 feet 8¼ inches by 4 feet 11½ inches, but with the same thickness as the others—viz., 9 inches. This plate had been produced in accordance with Sir Joseph's recent specification, the principle of the invention being to localize the action of the projectile when striking, and also to facilitate the hardening of the material by means of oil. But in this case it happened that the plate had not been oil-hardened. The plate itself was formed of a low quality of metal which is known as Whitworth's fluid press steel. It possesses about two-thirds the weight of iron, no less than 34 tons alone being saved in the two screw-shafts of the Inflexible. Where, as in land defenses, weight is of no consequence, and where the armor can be thickened at pleasure, Sir Joseph Whitworth proposes to simply perforate the plate, by which its tendency to crack on impact is diminished and the spreading of fissures is prevented. But as the plate in question was intended for the protection of ships of war, lightness was of supreme consideration. Accordingly, after the low steel had been drilled through into a series of holes, each 4¾ inches in diameter, and spaced from each other at certain uniform distances, a hardened steel plug, equal to a resistance of 100 lbs. to the square inch, was screwed into each of the perforations, the ends being cut off flush with the front and back of the plate. This arrangement enables the inventor to obtain the requisite strength with less thickness and weight of armor. The four plates to be submitted to experiment were suspended across the battery.

They were fixed to a transverse wood bulkhead built across the ship from side to side, consisting of two vertical and two horizontal layers of oak baulks, and making in all about 3 feet 6 inches of thickness, the whole being shored at the back by substantial wooden spalls, which were themselves secured by a massive thwartship transom. The gun, a 12-ton 9-inch muzzle-loading rifled gun of Woolwich pattern, stood behind a thwartship wooden bulkhead erected at a distance of 30 feet from the targets, and it was fired through four apertures answering to the ports of a ship, each aperture being in direct line with one of the experimental plates. The ports were screened by rope mantelets. The charges consisted of battering charges of 50 lbs. of pebble powder, and the projectiles were chilled Palliser shots weighing 250 lbs. The Whitworth plate was first attacked, and it was much broken and battered by the repeated blows. The sub-carbonated target, which bore the trial best, was next operated upon, then the iron plate faced with steel, and lastly the plate of steel between two layers of iron. The conclusion to be drawn from the trials is that further experiments will have to be made before a perfect substitute for iron is produced. None of the steel or composite plates were enabled to survive the ordeal, their complete disintegration being effected at the third shot. But it was conclusively shown that shot and shell can be kept out of a ship by means of steel armor, the great difficulty being how to keep the new armor from cracking and falling off under fire. Projectiles will readily pierce the best iron manufactured, though in iron the damage is confined to puncturing, and is clearly localized.

It seems probable that the above experiments are intended to bear on the question as to the kind of armor which may be best for the turrets of the Inflexible. The gradual increase of power of late years in the gun on the one side, and the armor-plate defenses on the other, appears to have reached its culminating point in these experiments. The Thunderer, Dreadnought, Devastation, and Glatton—the heaviest-armored ships in the service—having 14 inches of iron plating, backed by 18 inches of timber and 1¼ inch of iron skin, and requiring for their penetration an energy of 198 foot-tons per inch of the shot's circumference, can be perforated in their turrets by the 35-ton gun up to 500 yards with battering charges of pebble-powder, while their breastworks would be riddled up to the same distance by the guns of the Monarch, and up to 1,700 yards by the 35-ton gun. The sides of the Hotspur and Rupert, formed of 11-inch armor, 12 inches of backing, and a skin 1¼ inch thick, can be thoroughly penetrated by the 18-ton gun up to 500 yards; and the sides of the Cylops, Gorgon, Hecate, and Hydra, the turrets of the Monarch and the armor-belt of the Audacious, Iron Duke, Invincible, Swiftsure, and Triumph, can be pierced by the 12-ton gun up to the same distance, and by the 18-ton gun up to 2,400 yards. The flag-ships of the Channel Squadron, the Minotaur and the Black Prince, which look so imposing in the water, and even the crack ironclads of the Hercules, Sultan, and Bellerophon class, may for all practical purposes be regarded as unarmored vessels, seeing that the former can be perforated by the comparatively insignificant 6½-ton gun up to 1,100 yards, while the latter could be placed *hors de combat* by the same gun at 400 yards. The Inflexible was originally intended to have turrets, composed of iron walls, having a solid thickness of 18 inches, the citadel being constructed at the water-line of two thicknesses of 12-inch armor plating. She was designed to withstand an attack from a 60-ton gun. She will, however, be fitted with four 80-ton guns. Yet the power of a gun of even this enormous weight has been surpassed by the ordnance belonging to the Italian Government, which was tried recently at Spezzia. It is understood that Sir William Armstrong's firm has in hand, or on order, 120-ton guns for ships of 13,000 tons displacement for the Italian navy. Numerous experiments have been made with the view of obtaining a stronger plate without increasing the weight. Combinations of iron and steel have been tried, in which the chief difficulty has been caused by the circumstance that the welding temperature of iron differs considerably from the welding temperature of steel. The compound steel and iron plates which were made for the present series of tests were composed of steel high in carbon, and were, as a result, exceedingly hard. The welds had been obtained by first heating the iron plates to a good red heat in the furnace; while hot the molten steel was poured upon its surface, and, as the temperature of the molten steel was much in excess of the welding temperature of the iron, the face of the iron plate became partly fused by the overlaying liquid steel, and a complete union, or weld, was thus effected between the metals. A third metal, or semi-steel, was formed between the two by a portion of the carbon of the steel running into the iron. By these means the two plates became inseparably joined together by a zone of semi-steel, which has been found to vary in thickness from an eighth to more than a quarter of an inch. Experiments have been made for the purpose of ascertaining the relative strength of the weld obtained by this method, and on each occasion the iron has been actually torn asunder out of the solid, while the juncture has remained undisturbed. The results of the experiments at Spezzia induced the Italian Marine to adopt steel for armor in preference to iron. The Government were led to this determination for the simple reason that the projectiles fired from the 100-ton gun failed to pass through a target faced with 22 inches of that metal, while similar projectiles from the same gun perforated targets composed of iron plates of the same thickness. The recent experiments at Portsmouth show that, so far, our Government have good grounds for doubting the propriety of the decision at which the Italians have arrived, and that a perfect substitute for iron, as a means of resisting the huge projectiles of modern warfare, has still to be produced.—*London Times.*



CARVALHO'S FEED WATER HEATER AND SUPERHEATER.

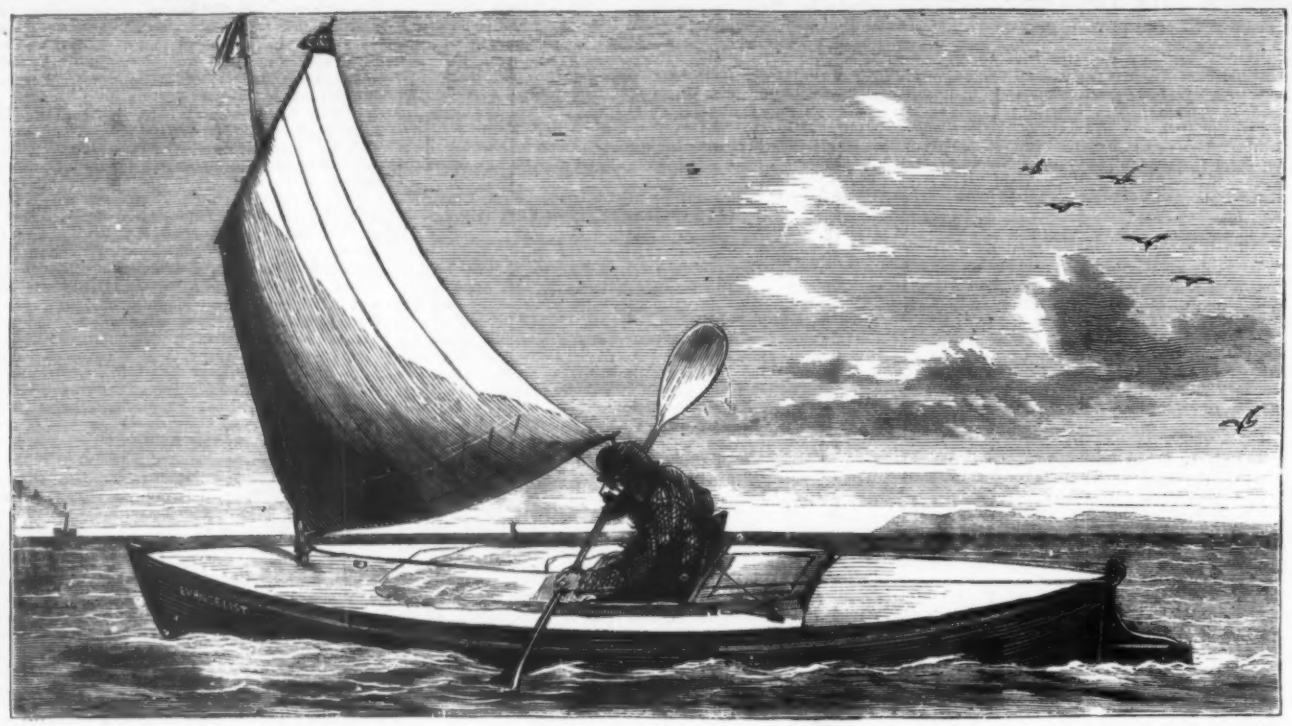
the cylinder would be accomplished. The two greatest obstacles to the attainment of these conditions have been the perishability of superheating apparatus and the difficulty of controlling the exact amount of superheat given the steam.

The use of the apparatus is not confined, we are informed, to the drying and superheating of steam on its way from boiler to engine, but the main circuit of pipes connected with the feed water tank and absorbing surfaces in the hot region communicates with a hot water jacket around the cylinder, and the circulation of water in this, the inventor asserts, evaporates any entrained water and superheats the steam directly in the cylinder, the action being regulated by suitable devices. The invention is also claimed to be adapted to many other industrial purposes, as the boiling of soap and sugar, baking of bread, biscuit, etc.

Referring to our engraving, A is a reservoir with safety valve and funnel, and at B are the absorption pipes in the back connection; C is a superheating coil in an annular drum or plain, and there is another coil in the feed water tank, D. A valve, E, is provided on the coil from the superheater, C, and valves, F, are arranged on the exit pipe from the feed water tank. When valve E is open valves F are closed, and the feed water tank is thus shut off from the system. G is a valve connecting with the feed pump for filling under pressure. A funnel is provided, as shown, for filling by hand. I is the feed-pipe entering tank, D, and J the pipe from tank to boiler. Fig. 2 shows the hot water jacket around the cylinder of the engine in connection with the absorption pipes and feed water tank. Steam is thus superheated in the cylinder instead of in C. Fig. 3 shows a coil of pipe inclosed in a metallic oven to take the place of feed water tank, D. The surplus heat in pipes of superheater, C, is regulated by its radiation to contents of the oven. Fig. 4 represents a plain wrought iron cylinder or pipe with coil of tubing, to take the place of the double cylinder, C. This is intended to be placed around the smoke stack of a marine boiler.

Among the other advantages claimed are that at no point of the entire apparatus is there a square inch of surface exposed to the heated gases which does not have water on the

THIRTY-THREE iron rolling mills in Pittsburgh and vicinity produce annually, when running full, about 35,000 tons of bar, sheet and plate iron; also about 1,200,000 kegs of nails. The value of the product may be assumed at about $20,000,000, figuring from the amount of pig metal consumed. In steel, as in iron, Pittsburgh is the most important manufacturing city of the United States.



THE LIFE BOAT CANOE EVANGELIST.

THE LIFE BOAT CANOE EVANGELIST.

THE "Evangelist" traveling canoe was built under the supervision of Mr. John Macgregor, the inventor of the Rob Roy canoe, in February, 1877, at Searle & Co.'s boat yards, London. This tiny vessel gives the results of many years' canoe traveling, and is constructed on the model of the canoe used lately by Mr. Macgregor among the Orkney and Shetland islands. The canoe cannot sink, as it is provided with air chambers, and the owner can carry in it all that is needful for his comfort during a long voyage. Drawn up on shore, its waterproof cabin is a comfortable lodging at night, and the "Rob-Roy *cuisine*" boils water in less than four minutes, and can be packed away with its fittings in a small waterproof bag. A double-bladed jointed paddle is a great convenience, as one blade can be taken off and the single paddle used. The tiny craft is provided with mast and lug sail, and a back board against which the traveler reclines while he steers the boat with one foot. A lengthened trip in this beautiful little vessel would not, for many persons, be either safe or comfortable, as considerable nautical experience is required, with nerves and muscles trained and hardened by exposure to the exigencies of a wandering life. Twelve years of travel and adventure in all parts of the world, during which Mr. Fairey made navigation a study, has been his preparation for lone traveling on Australian waters. We understand the boat is not to be used merely for pleasure, the owner desiring, on his annual trip, to visit many families cut off from Christian ordinances, and as a minister of the Gospel try and do them good; and he hopes on his return to be able to follow the example of his friend Mr. Macgregor by using the materials furnished by his voyages in lectures, etc., for the benefit not only of himself but of Christian and benevolent institutions. The canoe is made of English oak, cedar, and mahogany, weighs 79 lbs., is 12 feet long, 28 inches wide, and 12 inches deep. Mr. Fairey has been enrolled by Mr. Macgregor as a member of the Royal Canoe Club, of which the Prince of Wales is the commodore. The canoe "Evangelist" will be entitled to carry the blue burgee of the club, on which is a crown and double C.—*Illustrated Adelaide News.*

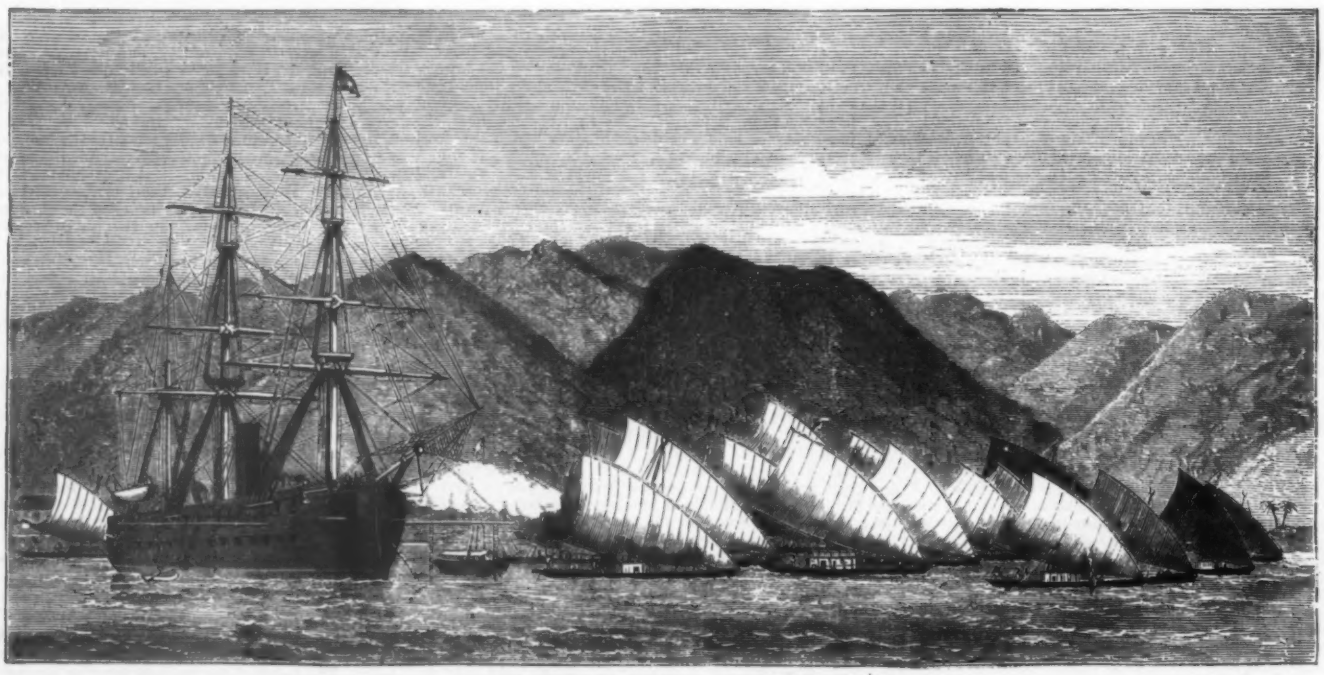
CANOE RACE AT WAIKIOU, FIJI.

THE group of islands known as the British colony of Fiji number about 150 islands altogether. There are only two of any considerable size, the largest being Viti Levu, or Great Fiji, 120 miles long and about 400 miles in circumference. Roads, even now, are unknown in most of the islets, and to travel round the coast from place to place, or to pass from island to island, the ordinary mode of conveyance is by native canoe, in the management of which, from constant practice, the natives are very expert. The canoes are handsomely proportioned, well built, and large, some of them being from forty to fifty feet in length, with a proportionate breadth, and decked over in the center, forming a platform on which in the larger vessels a deckhouse or cabin is erected. They have pointed prows and sterns, and are steered with an oar. Those intended for sailing vessels are fitted with a mast, which is stepped abaft the deck, and made to rake forward. To the mast a yard of bamboo is slung, and to this a shoulder of mutton or lateen sail is rigged, which appears out of proportion to the size of the boat. Formerly all these vessels were fitted with an outrigger, which prevented any capsize, and they are to be seen now most frequently, but not always. The native Fijians are fond of exhibiting their prowess in seamanship, and upon the occasion of a visit made by H. M. S. Nymphe to Waikiou, in the island of Vanna Levu, they improvised a canoe sailing race, which came off as shown in the illustration. The appearance of this fleet of Fijian yachts was very trim and graceful, and their crews displayed great skill in sailing and maneuvering their vessels, and evinced a most laudable desire to excel in the competition.—*Illustrated Adelaide News.*

IMPROVED BILGE WATER INDICATOR FOR SHIPS.

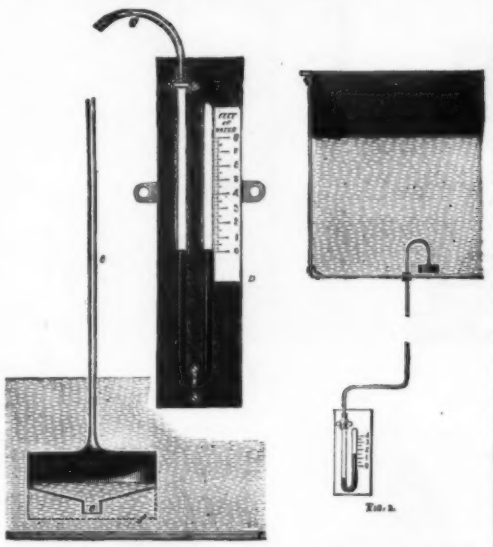
THIS device, by Rayne & Charlton, of Newcastle-upon-Tyne, is for measuring the depth of water contained by ships or other closed vessels, which we now illustrate. This new instrument has within the last few months received a great deal of attention on the Tyne, where it has been well tested. In a steamship fitted with this "automatic sounder"—as probably from its analogy to sounding apparatus proper it has been called—the traditional weather of the Bay of Biscay gave an opportunity for a thorough trial, and the report on her return from a voyage to Spain was highly favorable to the instrument.

An open-bottomed box, B, fitted permanently near the bottom of the ship's hold, communicates by means of a tube, C, which may be of any length, with a siphon indicator, D. The liquid in this siphon or gauge is mercury, and the end open to the atmosphere is constricted. As water rises in the hold, the air is driven out of the box, B, by the upper aperture, and exerts a certain pressure upon the mercury, which rises in the open limb, showing by its height on a graduated scale the exact amount of water in the vessel. The lower opening, *e*, of the box, B, is protected from fouling by dirt by a perforated rose, *f*. The gauge is not affected by variations of temperature.



FIJIAN CANOE RACE.

The lead and line have now hardly any claim to be retained for sounding purposes. It is, as is evident, perfectly easy to fit an automatic sounding apparatus, so that the chief officer of a ship can learn all that is necessary without leaving his cabin or his chart-room. This is a point of some importance in ships of war, now machinery is so largely relied upon that the proportion of men to tonnage bears no comparison to the practice of our predecessors. A similar remark applies to merchantmen, where labor-saving is of at least



IMPROVED INDICATOR FOR BILGE WATER.

equal importance. Here, also, the captain should have under his own eye an infallible indicator of the state of water in his hold and tanks, as well as the water ballast. In rough weather, or in case of accident, he could learn at a single glance what the old-fashioned sounding pipe could never tell him.

Our second figure shows an adaptation of this sounder to land purposes, as an overhead cistern.—*Iron.*

JAMIESON'S GRAPNEL FOR SUBMARINE CABLES.

THE kind of grapnel ordinarily employed in picking up submarine cables for repairs is that known as the centipede grapnel. It resembles a compound fish-hook in shape, the stem or shank being set round with several prongs or flukes which catch the cable as the grapnel is dragged across it over the sea bottom. The flukes are rigidly welded to the stem, and one disadvantage in this form of grapnel is its liability to have its flukes broken off if it catches in submarine rocks or other obstructions on the bottom. When such a grapnel loses two or three of its flukes it is unsafe for use; and it is no uncommon thing for a repairing ship working over a rocky bottom or among coral to have four or five centipedes rendered *hors de combat* during a morning's work. Another disadvantage of the centipede, too, is that the cable is apt sometimes to escape from the flukes after it has been caught. To remedy this a form of fluke has been designed which has an arm from the shank ready to close automatically on the cable as soon as it has been hooked, and so prevent its jumping out again. Mr. Jamieson's grapnel is designed to overcome both of these defects in the ordinary centipede. It is intended to be self-relieving when it comes in contact with rocks or other irregularities and obstacles at the bottom, so that no undue strain is thrown on the grap-

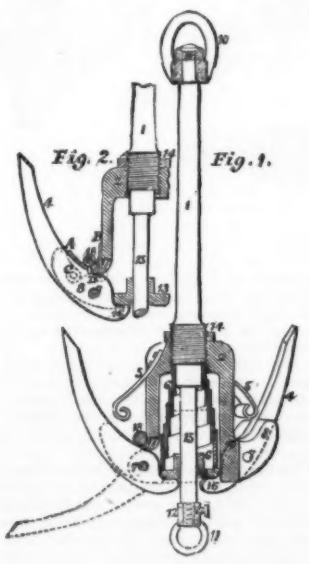


Fig. 2. Fig. 1.

nel itself, or on the rope and machinery working it, and it is also intended to be capable of retaining the cable when caught. These are advantages calculated to greatly facilitate the operation of grapneling in some waters.

The principles of the new grapnel can be applied to the centipede form; but they are best exhibited in the simpler and preferred form of the common grapnel, as shown in the engraving. At the lower end of the grapnel shank there is fixed a boss for containing a spring which exercises a pressure upon the inner ends of the grapnel toes, as the outer portions of the flukes are called. The toe portion of each fluke is free to move round a center or fulcrum carried by the joint of the fluke which is rigidly fixed to the boss, so that when the toe encounters a rock or other obstacle of the kind it yields to it, turning round on its fulcrum, and thereby exercising a compression upon the spring until the obstruction is cleared, when the recoil of the spring restores the toe to its former position. When, however, the grapnel meets the cable the latter lies in the joint of the fluke where it is attached to the boss, and it is retained there by a spring which juts out from the boss and arches over it so as to hold it in.

Fig. 1 represents a sectional elevation of the improved grapnel. The shank, marked 1, carries at its foot a cylindrical boss, 2, which may be made of cast steel, iron, or bronze, and which contains and protects the spring, 6, which may be of steel or india-rubber, and constructed on the volute, spiral, or other principle, but preferably the volute. Round the lower end of the boss, 2, project the joints of the fluke, 8, which are cast solid with the boss, each pair of joints embracing a pointed toe, 4, of wrought iron or steel, which is held in position by the fulcrum pin, 7, round which it is capable of revolving.

The shank, which has attached to its upper end a shackle, 10, provided with a swivel joint, is firmly screwed to the boss by a long coarse-pitched thread, secured by a jam nut, 14, in any desired position. According as the shank is screwed into the boss, the pressure of the spring on the toes of the flukes, and consequently the pull on their points at which the toes begin to turn round, is regulated. Within the boss the diameter of the shank is reduced, as shown at 15, and the reduced portion passes within the spring, and terminates in a screwed end, 12, to which is attached the shackle, 11, for the length of chain which is always trailed after a grapnel to hold it well down on the bottom and keep it from skidding or jumping. A movable piston, 13, capable of sliding up the reduced part of the shank, 15, acts as the head of the spring, and presses on the inner ends of the toes of the flukes. A steel spring, 5, juts from the boss opposite each toe in order to guard the cable, shown in section at 18, from slipping out of the fluke when once caught, and also to protect the joints of the flukes from injury by obstacles.

The grapnel operates in the following manner: The toes when engaged by rocks or other obstructions are pressed outward and rotate round their respective fulcra, their inner ends bearing against the movable piston, 13, which compresses the spring up the boss; a movement which may continue until the toes move round to the angle shown by dotted lines on the left hand of Fig. 1, an angle amply sufficient to relieve the toes from the obstruction. As soon as the toes are released, the piston is forced down again by the reaction of the spring, and, bearing against the toes, restores them to their initial working angle. This angle is fixed for each grapnel by the shoulders, 17, on the boss, 2, which act as stops between the boss and toes, preventing the latter from bending in toward the shank.

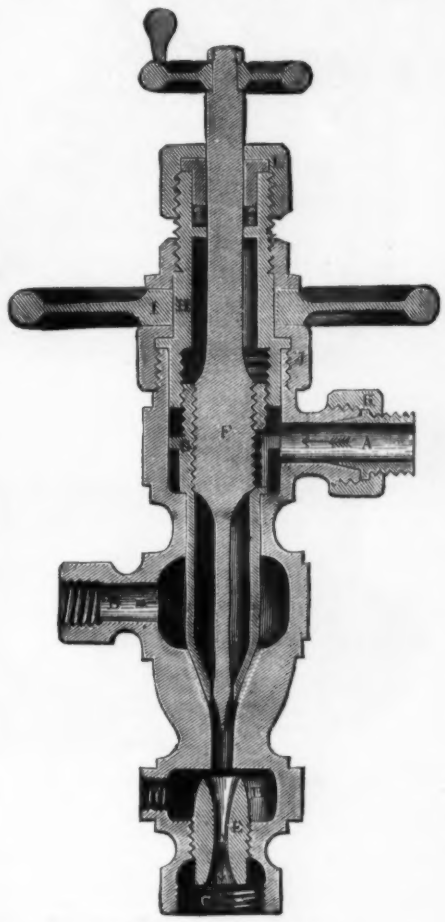
In Mr. Lambert's patent grapnel provision is made for cutting the cable when it is caught and retaining one end only, which is brought up to the surface along with the grapnel. Mr. Jamieson also combines with his grapnel an arrangement of cutting shears for severing a cable or torpedo line, as shown in Fig. 2. In this figure A and B are two steel knives or shears mounted on respective fulcra, C and D, and capable of rotating round them. These knives are ground sharp in their upper edges, on which the cable, 18, rests. When a strain is produced on the cable by hauling in the grapnel, these knives shut on each other and shear the cable in two. Serrated clamps, arranged similarly to the knives, are also employed on alternate flukes for retaining one end of the cable in order that it may be drawn up to the surface. We understand that this new form of grapnel has already proved of valuable service on the repairing expeditions of the Western Brazilian Telegraph Company, whose coast cables are at some places laid on coral bottoms very fatal to the ordinary stiff fluked grapnel, and we also hear that it has been adopted by the Eastern Telegraph Company, who may find it a decided gain among the reefs of the Red Sea and along the north coast of Africa.—*Engineering.*

HART'S IMPROVED INJECTOR.

IT is now eighteen or twenty years since Mr. Gifford introduced his patent Injector to the engineering world, and the utility of the invention having been at once recognized, it soon came to be extensively applied for all classes of steam boilers—stationary, locomotive and marine. It has many advantages over the steam feed-pump, being cheaper to manufacture, less liable to get out of order, and capable of working when the main engines are not in motion. From this last consideration it has been found particularly valuable for locomotives, and especially for use with goods trains, which are liable to long periods of detention in sidings; the drivers, on these occasions, before the injector came into use, having often had great trouble in getting sufficient water into the boilers owing to the limited space at their disposal for working the engines, a difficulty, of course, that would not arise after the injector was attached, which could fill the boiler while the engine was standing still. Yet with all these excellent features it is very well known that the injector has at least one most serious drawback. It is very far from "reliable," its uncertainty of action being such that at times it becomes, without any apparent cause, absolutely inoperative, as if willfully and of set purpose refusing to do duty, baffling all the efforts of the engineer until there is no water in the gauge-glass, when he is at last compelled to draw the fires, to the pecuniary loss of his employer, and to his own great vexation.

With a view to obviate this great defect the injector we now illustrate has been designed, for which it is claimed that its immediate action is certain, the statement, we believe, being substantiated by results actually obtained; by which it would appear that in time the steam-pump may be dispensed with as a boiler feeder. The mode adopted by Mr. Hart for securing certainty of action consists in the provision of an appliance in the interior of the apparatus for regulating the admission of water and steam, so that the force of neither may be too great for the other. As with the older form of the implement it was possible to open or close the cocks or valves exterior to it, or to open them partially to any extent desired, this might leave room for the occurrence of the difficulties that have been experienced. By the arrangement in the injector before us, the flow is regulated at the very cones of the instrument, instead of at a distance from it.

In our engraving, A represents the steam-pipe, B the water-pipe, C the delivery to boiler, D the air-chamber and overflow, E the regulating case, F the steam regulating spindle, G the cone of the injector, which is fitted to be moved up and down by means of the connection H and the hand wheel I, for the purpose of regulating the supply of water; J a removable cap, K a union coupling joint, and L a gland nut. The injector is shown closed, and to set it to work the engineer has to admit the water into it by raising the regulating nozzle, G, as far as it will go; then, by raising the steam-spindle, F, to admit the steam through the slot in the regulating nozzle until water issues from the overflow at D; then to close the water regulator until the water ceases to pass from the overflow and a noise is heard from it, the injector now being in full work. With this regulating arrangement the steam is not allowed to overpower the water, nor the water to flood the steam, and it is clearly possible, when the engines are in motion, to set the apparatus



IMPROVED INJECTOR.

so that the quantity of water passing into the boiler shall be equal to that consumed, and, the injector being kept constantly open, the height of the water in the boiler may be maintained at its most favorable position. Another important point in this injector is that in case of breakage or choking from dirty feed-water, the whole of the working parts can be taken out, overhauled, and put in place again while the boiler is at work. To do this it is only necessary (as will be readily seen from our section) to remove the large nut or cap, J, which is immediately under the regulating wheel, and, as the pieces are all made interchangeable and to standard gauges, any broken part can be immediately replaced if spare parts are at hand. This facility for overhauling is certainly a great recommendation, particularly for locomotive injectors, which could thus in many cases be repaired on the line instead of being taken into the shed. A special pattern is made for locomotives.

The patentees claim for their injectors, in addition to certainty of action, extraordinary power; and, as an instance of their capabilities, we are informed that a No. 8 injector, which has been working for the last six months at the large Printing and Bleaching Works of Messrs. E. & J. Buckley, Brookside Mills, West Leigh, Hindley Green, is feeding a large Cornish boiler from a running stream 15 feet from the boiler house, and lifting the water a height of over 12 feet, being also used for supplying the dye tanks, etc., with hot water. The injectors may be fixed either vertically or horizontally, though the former is preferable. The Nottingham Eng., Malleable Iron Company are the makers.—*Iron.*

THE NEW OIL REGIONS IN KENTUCKY.—The Titusville Pa., *Herald* says: "The new oil region in Kentucky takes its start nearly at the fork of the new well at Spring creek, on Roaring river, near the line of Putnam and Overton counties, Tennessee, and runs in a northeast direction, the outer lines of the belt being on Big South Fork for the south and southeast line, and Cumberland river for the north and northwest line. This line includes some of the finest oil tracts in Overton, Fentress, Clinton, Wayne, and the southeast part of Cumberland counties, the oil springs and seeps on Obey's river, its east and west forks, together with Wolf river, which makes in from Tennessee, and runs into Clinton and Wayne counties, Kentucky. Oil springs of the most productive character are found thickly scattered for a hundred miles along the direct line, which eventually runs, in the direction of northeast to southwest, into the oil belt of West Virginia and Pennsylvania. A number of largely producing wells have also been sunk on this territory, one of them, the English well, producing 1,200 barrels a day when first struck, and after it was tubed and pumped yielding nearly 200 barrels a day for a long time. At Franklin's creek, in Fentress county, oil flows out of the bed of the river, immediately under a bluff, 300 feet high. By riding a horse in the stream, about a mile above the mouth of Obey's river, where Franklin's creek empties into it, oil will come to the surface, and pebbles at the bottom of the stream look as though they had been immersed in petroleum. All along the western edge of Fentress county oil springs in any quantity may be found. There is a group of such springs near the mouth of Poplar Grove creek, and several on East Fork."

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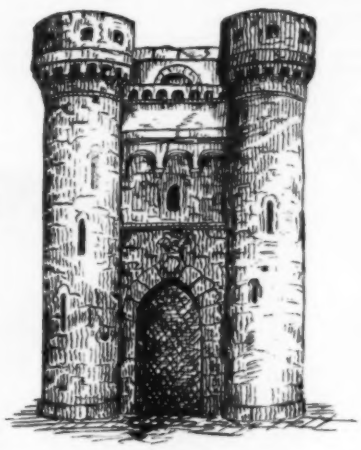

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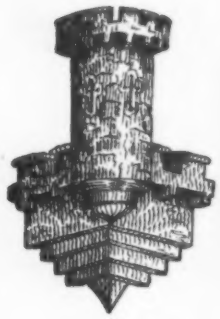

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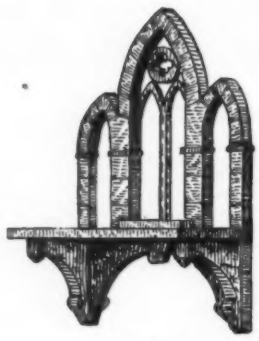

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ORNAMENTS

FOR THE MANTEL AND THE WALL.

ORNAMENTS FOR THE MANTEL AND THE WALL.

By GEO. M. HOPKINS.

IT is the purpose of this article to suggest a class of ornaments that are easily and inexpensively made, and will compare favorably as to attractiveness with articles that are far more costly.

The objects are to be made in imitation of stone structures, either as architectural models or picturesque ruins.

The materials required are some cork shavings and blocks of inferior cork, a wooden or pasteboard box, two sheets of fine emery paper of different colors, and a small quantity of shellac varnish.

The tools required are a pocket knife, a long knife, such as is used for cutting bread, and a miter box fitted to the long knife.

Having decided upon a design for the article, take, for example, the turret, Fig. 3; select a round box of suitable dimensions, say four inches in diameter and six inches high. This is to be fitted to a triangular supporting piece which may represent the corner of a wall. To the cover of the box blocks of cork representing battlements are fitted and glued, and smaller blocks are placed underneath the battlements to represent dentals or brackets. The supporting piece is also provided with battlements, and the body of both turret and wall are covered with cork shavings attached by means of glue. These shavings are arranged to break joints, as in masonry. It is less labor and expense to use cork shavings from the factory than to prepare the shavings from the blocks, but the latter is preferable, as the pieces may be cut of a uniform thickness and the cork may be cut at different angles to the direction of the grain, so as to get different varieties of marking on the face of the pieces.

The best way to cut the cork is to soak the blocks for an hour or so in hot water, and then by aid of the miter box, which is provided with an adjustable gauge, cut the blocks into pieces having a transverse section of the form and size of the thin pieces to be attached to the model.

The gauge in the miter box is then adjusted to cut thin shavings (about 1-16 inch in thickness) from the pieces prepared as above.

As we observed, it is well to cut the shavings at different angles to the grain of the cork, to give variety to the surface.

The long knife needs frequent sharpening. This is easily done by means of an ordinary "steel," which gives the knife a good edge for the purpose.

The cork may be cut in different ways for different kinds of masonry. For plain ashlar, shown in Fig 9, the plain rectangular shavings will be used. For rusticated ashlar, Fig. 8, a shaving is planted upon another of larger size, and for rough ashlar, Fig. 7, the shavings are cut thicker and afterward beveled by placing under them an inclined support in the miter box and cutting away a portion of the face.

The natural color of the cork represents some kinds of stone, and a beautiful effect may be secured by dyeing a part of the shavings, such, for example, as represent the stones of an arch, as in the window garden, Fig. 1, the stones being alternately light and dark.

A convenient and appropriate dye for coloring the cork will be found in the ordinary chemical writing ink or in common black ink, either of which must be considerably diluted with water.

The blocks and shavings should be dipped in the dilute ink and allowed to dry before attaching them to the foundation or model.

When the article is complete and dry it may receive a light coat of shellac varnish, which will preserve the colors and render it easily cleaned.

An almost endless variety of ornamental and useful articles may be made in this way.

The window garden, Fig. 1, consists of a rough pine box, which is covered with cork shavings of different thickness, the thinner ones forming the panels under the arches, and the thicker ones the arches, pilasters and cornice. The box should be painted inside and varnished outside to render it waterproof.

The earth for the plants should not be put directly into the box, but into pots which are placed in the box and hidden by it.

The clock tower, Fig. 2, is simply an apertured box covered with cork and provided with a pasteboard roof, which is covered with slate made from the two kinds of emery paper and arranged in alternate rows of light and dark.

The clock movement may be purchased for a small sum, and if it be a strike movement the hammer arm may be easily connected with a hammer in the belfry, which will strike the bell in true tower clock style.

The ruined gateway, Fig. 10, may be made so as to contain a pot of ivy, smilax or Japanese fern, which may be trained over the ruin, making a beautiful object. Fig. 11 represents another gateway. The turrets, Figs. 3 and 6, may be fastened to the wall, and will serve as receptacles for small articles.

A frame is represented in Fig. 4, and a bracket in Fig. 5, and bits of old masonry are shown in Figs. 12 and 13.

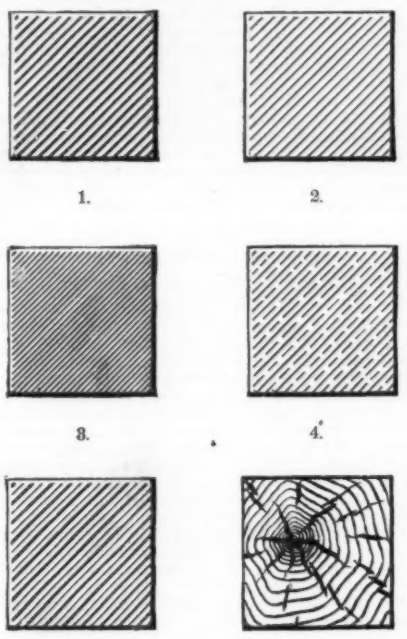
The illustrations present a few examples of what may be done in this way. More elaborate designs may be selected, and different subjects will suggest themselves to one desirous of making ornamental articles of this character.

SECTION LINING.

A COTEMPORARY, under the caption "Sectional Shading, suggests the desirability of absolute uniformity of usage in respect to "Sectional Shading" to represent the various materials used in construction. Although nothing is said in the article about mechanical drawing or practical draughting, it may be inferred that the specimens of section lining submitted are intended more especially for draughtsmen and those engaged in the industrial arts. The term "sectional shading" is a misnomer, as there is no shading in representing sections of metals and materials. Sections should be indicated, as are metals, by conventional rules. The systems vary and are not of "absolute uniformity." The writer also speaks of "horizontal, *perpendicular* and *vertical* lines, varied with dots" etc., and an inquiry may be made respecting the difference between a *perpendicular* and a *vertical* line.

The lining of sections is drawn at an angle of 45°.

The different metals and materials most commonly used in



the construction of machinery are cast iron, wrought iron, steel, brass, copper and wood. The accompanying cuts are given and submitted for general usage. They receive the approval of experienced mechanical and practical draughtsmen.

Of course where drawings are tinted and shaded, sections may be tinted also, but in plain line drawings the section lining here given will answer the purpose very well.

Fig. 1 ..... Cast iron.
Fig. 2 ..... Wrought iron.
Fig. 3 ..... Steel.
Fig. 4 ..... Brass.
Fig. 5 ..... Copper.
Fig. 6 ..... Wood.

The lining of sections is frequently done too closely and takes up much of the draughtsman's time, besides making the section parts too dark and prominent.

THE ART OF DYEING.

THE history of dyeing is enveloped in considerable obscurity. It dates back from time immemorial, and seems to have been practiced by the Persians, Syrians, Egyptians, and natives of East India. We find frequent mention in the Pentateuch of linen cloths dyed blue, purple, and scarlet; of rams' skins dyed red. The works of the Tabernacle and the vestments of the high priest were commanded to be of purple. The Tyrians were probably the only nations of antiquity who made dyeing their chief occupation and staple of their commerce. The opulence of Tyre seems to have proceeded in a great measure from the sale of their rich and durable purple. It is unanimously asserted by all writers that a Tyrian was the inventor of the purple dye about 1,500 years before Christ, and that the King of Phœnicia was so captivated with it that he made purple one of his chief ornaments, and for many centuries after Tyrian purple was the badge of royalty. So highly prized was this color that in the time of Augustus a pound of wool dyed with it cost, at Rome, a sum nearly equal to £30. The Tyrian purple is now generally believed to have been derived from two different kinds of shellfish, described by Pliny under the names of *Purpura* and *Eucumia*, only one drop being obtained from each fish. After the goods were immersed in this liquid its development was peculiar; first it was colorless, next citron yellow, green, azure, red, and in the course of 48 hours a brilliant purple. I may say we now dye a purple of greater brilliancy, but lacking durability, for, say, 1d. per lb. In ancient Greece it does not appear that the art of dyeing was much cultivated. In Rome it received more attention, although the art was held there in very low estimation, and progress in dyeing was completely stopped in Europe for a time by the invasion of the Northern barbarians in the fifth century, and did not revive again till toward the beginning of the thirteenth century. One of the places celebrated for this art was Florence, where it is said there were no less than 200 establishments at work early in the fourteenth century. It was a Florentine dyer who found out the lichen from which archil, cudbear, and litmus are made, and who acquired by its sale an immense fortune.

The discovery of America tended very much to develop dyeing, as many new dyes were added, such as logwood, quercitron, Brazilwood, cochineal, and annotto. About the year 1650 another improvement was made by the discovery of salts of tin, which, with cochineal, produces a most brilliant color. Logwood and indigo began to be employed about the middle of the sixteenth century, but not without considerable opposition from the cultivators of the native woad, which is now produced in Lincolnshire, and employed along with indigo for preparing what are known as the "woad vats," and most extensively in Yorkshire for navy blues and all blues of similar character. Logwood and indigo were prohibited in England by Queen Elizabeth under a very heavy penalty, and all that could be found in the various dye-houses in the country was ordered to be destroyed, and their use was not permitted in the reign of Charles II. Indigo at the present time is one of our principal dyes. It is a native of India, although it is cultivated in many tropical countries. A considerable trade is done in Bengal, from whence we get such large amounts. It was denounced as "food for the devil," and forbidden by Parliament, and this act remained in force for the greater part of 100 years. When these prejudices were overcome, in the eighteenth century, dyeing made remarkable progress. To the Indians we are indebted for the discovery of Turkey-red. The following is a Swiss method for 440 lb. cotton: 29½ lb. fat oil, 55 gals. of carbonate of potash, 13½ gals. cow-dung, fermented and brought into a pulpy state with cow-urine (the above is repeated four times), 117½ lb. oil, 220 lb. carbonate of potash, 55 lb. cow-dung, 16½ lb. gall nuts, 14 lb. Silesian sumac, 47 lb. alum, 77 lb. c. potash, 50 lb. madder, 6 lb. sumac, 374 gals. oxblood, 11 lb. soap, 66 lb. chloride of tin, 280 lb. nitric acid. The time occupied was, in some instances, two months. We can now dye a corresponding color in two hours on woolen.

It is not my intention to trouble you with a philosophical lecture on dyeing, or with abstruse chemical equations and formulas, which undoubtedly would be most invaluable to all dyers if they possessed a sufficient knowledge of chemistry, although I cannot resist making mention that if the chemist and dyer could assimilate or mix up their ideas more, I have no doubt of the result. Oftentimes when I observe those beautiful colors in our carpets, which can only be produced by long practice and observation, I feel persuaded that were the dyer's knowledge combined with thoroughly correct and scientific chemical information, the British dyer need not be ashamed nor fear any rival from foreign countries. I do not mean to infer that every chemist is a dyer, but I say the dyer ought to be a chemist. It has often been asked, Will reading and understanding chemistry make any person match colors any better? I say no; but it will let you know what chemical phenomena take place when certain stuffs are put into a vessel; it would also suggest and assist in producing new colors, which it is impossible to do without chemical knowledge. The fact is, the non-chemical dyer must always play second fiddle, and that fact alone must be very annoying to a sensitive man. We must all admit that whenever a new dye comes out—and their name is legion—it comes from the chemist. Chemistry would also suggest methods of altering any shades that have gone wrong in dyeing, and that very often takes place with the best of dyers, which is a most important and expensive item to manufacturers, for such colors are very often consigned to the black furnace, which means in the case of a cochineal red—an extreme case—say 6d. per lb. dyeing and the yarn of a much better quality than blacks are dyed from; then the same expense takes place in dyeing black as though it were fresh-scoured yarn. I say hundreds and thousands of instances as above have happened through the dyer's inability to make the necessary alteration.

Now, one most important and vital consideration in dyeing is good and pure water, as upon this depends the probability of good and lasting colors. I may mention that the impurities of water are carbonates of lime, magnesia, iron, sulphate of lime, etc. The water most suitable for dyeing must fulfill the following conditions: it must not be too hard; it must not deposit a brown sediment of oxide of iron when freely exposed to the air for some hours; nor show anything of a blue nature when a few drops of a solution of red or yellow prussiate of potash are introduced into it, which shows the presence of iron. I should strongly recommend every dyer to have a little litmus paper by him—turmeric and archil—the turmeric litmus paper is the most sensible to alkaline properties, turning it brown, and the archil litmus turns somewhat red in acids. It may be tested with some degree of accuracy by putting into it a little logwood, and making a similar test with distilled water. When it boils it ought not to throw up a reddish-brown scum of oxide of iron. Another and most simple test is to dye samples with distilled water, and afterward with ordinary dyeing water; and if results are about the same, you may rely upon its suitability for dyeing purposes.

Another most important item in obtaining good and solid colors is scouring; unless the material to be dyed is free from dirt, grease, and fatty acids, you cannot expect good results. Now, a great many articles are used for scouring, such as soap, soda, ammonia, urine, caustic soda, resin, pearlash, and many more, and it is hard to say which is best. Some prefer one and some another, and let me add that scouring naturally affects the colors according to method. I would sum up by saying, in all cases wash out the yarn in lukewarm water, after scouring, before dyeing, and let the yarn drain. I may mention that colors, as a rule, are dyed with a due regard to fastness according to where and what material they have to be worked into. For instance, the Kidderminster method of dyeing would not for one moment do for the cloth for West of England trade. And one class of shades which occupies no unimportant part of carpet manufacturing is the drab, which in cloth is more solid and much cheaper.—*G. Holdsworth.*

MILK OF SULPHUR IN DYEING.

By DR. M. REIMANN.

I PROVED years ago that the power of porous bodies to take up colors is of importance in the art of dyeing, provided only such bodies are white or light colored. I showed that silica, precipitated within the fiber of tissues incapable of themselves to attract substantive colors such as the anilines, renders them immediately fit to receive such dyes. Since that time silica has been practically applied in cotton-dyeing for fixing substantive colors. Even roughened glass and glass plates ground dull are capable of attracting or taking up permanently substantive colors, as the type of which the aniline dyes may be considered.

The application of aniline green in woolen-dyeing met with difficulties, because this exceedingly soluble color did not of itself fasten upon wool, differing in this respect from all other aniline dyes, which combine greedily with animal fibers. The first expedient adopted was to precipitate the green coloring matter in the dye-beck in the form of an exceedingly fine powder by the addition of alkalies; in other words, to put it in a condition in which it is readily taken up by the woolen fiber. The dull green shade thus produced on the wool was afterward brightened by a passage through acid.

This method has the defect that very much coloring matter is taken off during the acid treatment, and it is very difficult to hit the shade required in the alkaline beck.

It was then accidentally observed that wool which had been worked for some time at about 176° Fahr. in a solution of hyposulphite of soda mixed with muriatic acid was readily dyed an aniline green.

It has not been hitherto, however, ascertained to what the peculiar mordanting power of a solution of hyposulphite of soda mixed with muriatic acid was to be ascribed.

The conjecture lay, indeed, very near at hand, that the precipitated sulphur or milk of sulphur played here the part of a porous body just as silica does in other cases. Indeed, before this method came into use, wool was prepared with silica to fit it for the reception of aniline green. Hence it might be inferred that the sulphur acted, like silica, in virtue of its porosity. Still a direct proof was lacking that such was the nature of the action of milk of sulphur.

I therefore took a number of small hanks of woolen yarn, and, after preparing them by washing in the customary manner, I heated them for half an hour to 158° Fahr. in the solution of 15 grains of hyposulphite of soda in 52 ounces of water, to which 15 grains of muriatic acid were added. The liquid, turbid at first, became clearer after the introduction of the wool, and contained at last so little precipitated sulphur as to be but slightly opalescent. This is, to begin with, a proof that the precipitated sulphur is attracted by the wool. After dyeing the wool has a yellowish color, very decided when compared with fresh wool.

Of three hanks of dried wool one was steeped for some hours in sulphide of carbon. I then prepared an aniline-green beck in the customary manner. Into this liquid I introduced the hank which had been treated with sulphide of carbon and afterward wrung out and dried, and along with it a hank mordanted with milk of sulphur, but not afterward treated with sulphide of carbon, and a third hank of yarn which had not been sulphured at all. When these three hanks were worked in one and the same aniline-green beck, it was found that the first and second dyed up the same shade, while the third remained colorless. Thus we have proof that sulphide of carbon cannot remove the sulphur from the wool, and it is well known that precipitated sulphur is insoluble in sulphide of carbon.

A fourth hank of woolen yarn treated with milk of sulphur was boiled in dilute soda-lye. The wool turned yellowish and rough, as always happens if wool is boiled in a caustic lye. This hank No. 4, along with a fifth hank, which had been simply prepared with milk of sulphur, was dyed in a beck of aniline green. At first No. 4 was not dyed at all, while No. 5 took up the color at once. On adding more dye, however, No. 4 took up almost as much color as No. 5.

This is nowise strange, since, as I have remarked above, aniline green works on to unprepared wool in an alkaline solution. The trace of caustic soda, which, even after washing, had remained in the woolen fiber, was sufficient to make the beck slightly alkaline, and thus to effect a fixation of the green, though in a dull and impure tone.

In order to remove from the wool this trace of alkali, a sixth hank was first boiled with milk of sulphur, rinsed, boiled with soda-lye, rinsed again, and lastly treated with very dilute muriatic acid. The yellowish wool at once resumed its original white color, and the evolution of a trace of sulphureted hydrogen was perceptible. The hank was then very carefully washed, and along with a seventh hank, which had been simply treated with milk of sulphur, was steeped in a beck of aniline green. No. 7 took a good green shade at once; No. 6 took up no coloring matter, but appeared greenish on adding an excess of dye to the beck. Flowing water, however, completely removed this greenness and left the hank almost perfectly white.

It is to be remarked that in the last-mentioned beck No. 7 took up the color with rather more difficulty than usual under similar circumstances. I ascribe this to the trace of muriatic acid which the hank No. 6, though washed, had still introduced into the beck.

The above facts prove that wool mordanted with milk of sulphur takes up aniline green, but that after the precipitated sulphur has been removed the color ceases to be absorbed and fastened. The wool, therefore, is prepared for the reception of aniline green by the precipitate of sulphur. That the sulphur is present in the state of precipitated sulphur or milk of sulphur appears from the fact that sulphide of carbon, if allowed to act upon the mordanted wool, is unable to modify in any manner its behavior with the solution of aniline green. Eosine and its derivatives have recently also been fixed upon wool by the aid of precipitated sulphur. I shall also ascertain if the part played here by sulphur is the same as in the case of aniline green, and shall closely examine the possibility of the application of milk of sulphur for mordanting cotton and other vegetable fibers.—*Deutsche Chemische Gesellschaft.*

USE OF FERROCYANIDE IN ELECTRO-GILDING.

By ED. EBERMAYER.

IN a capsule holding 4 liters are dissolved 300 grms. ferrocyanide, 100 grms. carbonate of potash, and 50 grms. sal-ammoniac. On the other hand, 100 grms. of gold are dissolved in aqua-regia, the excess of acid driven off, and the chloride of gold dissolved in water so as to make up 1 liter. Of this liquid 200 c.c. are added, little by little, to the ferrocyanide solution; the mixture takes a blue color, which disappears gradually on boiling, while ferric oxide is precipitated. The liquid is let cool, filtered, and made up to 5 liters. This is the gilding-bath. As it is a bad conductor and deposits ferric oxide upon the anodes, the author adds a small quantity of cyanide, not sufficient, however, to evolve hydrocyanic acid on boiling. The gilding is performed at 40° to 50°. When the bath no longer gives a good deposit, 200 c.c. of the solution of chloride of gold are again added in the same manner, continuing thus till all the gold is consumed. But if the bath is to be used for still further quantities of gold, ⅛ of the quantity of salts directed above must be added to the bath. To recover the gold remaining in the bath when no longer fit for gilding, the author precipitates it electrolytically upon a plate of copper, but it requires to be refined. The object of the process is to avoid the use of large quantities of cyanide of potassium, so objectionable from a sanitary point of view.—*Dingler's Polytech. Journal.*

USE OF CHLORHYDRIN IN TANNERIES.—Since Knapp showed that the yelk of egg acts principally by means of the emulsified oil which it contains, attempts have been made to substitute other oils in a finely-divided state. The author proposes for this purpose an emulsion of oil of chlorhydrin, prepared by the reaction of glycerin and hydrochloric acid.—M. SEDLON, *in Dingler's Polytech. Journal.*

ANTIQUITIES FROM ARMENIA.

MR. LAYARD, Her Majesty's Ambassador at Constantinople, whose name is so closely connected with Assyrian explorations, has found time, among his many and arduous duties, to rescue from the oblivion of battle-fields in Turkish Armenia a series of most interesting antiquities. These have just arrived at the British Museum, and are found to be of very great interest, both from an artistic and philological point of view. The objects forwarded to England by Mr. Layard are a series of bronze architectural ornaments forming portions of the decorations of some royal palace of the Armenian monarch, and as they are the sole relics of the art of that ancient kingdom at present discovered, they will be much increased in value, and worthy the consideration of all students of Assyrian and Asiatic art. The first object, and the most interesting from an artistic point of view, is a bronze model of a winged bull. This figure is about 8 ins. in height and 6 ins. in length, and is modeled in an extremely fine bronze, containing a large proportion of copper, and is in very good preservation. The whole of the hind quarters and the forelegs and breast are those of a bull, while the head is that of a human being, with the torso and arms complete. The head of the figure has the hair plaited and dressed in the conventional style of Assyria, but the face is missing. This at first appears strange, but an examination of the vacant space shows that the face of the figure was that of a human being, and was probably made of gold, and cemented to the bronze by a layer of bitumen. The figure, unlike the majority of the winged and human-headed bulls from Koyunjik and Nimroud, has arms, which are folded across the breasts, with the hands clasped. The whole of this figure has been most richly decorated with gold, and the feathers of the wings and the horns of the head inlaid with ivory. On the head of this figure, as a species of adjunct to the horned cap which adorns it, is an ornamental pedestal of a small column which rested on the figure, and which supported some light superstructure. Round the arms of the figure are a pair of bracelets ornamented with a square pattern resembling the Greek ornaments. The next object of importance in the collection is a bronze figure of a bull *couchant*, which, unlike the figure just described, is entirely animal in its character, and is minutely accurate in the production of the animal form. It stands about 4 ins. high and is about 4¼ ins. in length. The head has the single pair of horns of the bull, and not the conventional triple-horned cap of the human-headed figure; but the face in this example also is missing. The minute accuracy in the modeling of the feet and hoofs of this animal, as well as the ears and horns, shows that the artist was a more attentive student of nature than were his Assyrian neighbors. Both the above objects bear strong indications of being executed upon Assyrian lines, the artificial decoration of the hair and the horned cap, as well as the pedestal, on the head of the human-headed bull, all indicating them as copies of Assyrian models. The couchant bull is, however, far more true to life than any antique from Nimroud. The new object of interest in the collection is a bronze foot of an altar or seat, which is of most massive and well designed workmanship, and which represents the conventional form of the paw of a lion. The upper portion is decorated with a panel on which is the winged circle, a decoration common to both Assyria and Egypt. The upper portion of this fragment has been richly decorated with inlaid ivory and embossed ornaments on the bronze. It is about 7 ins. in height and about 4 ins. in breadth, and the material is of a most solid nature. One point of minor interest connected with this object is the fact that it evidently bears indications of having in ancient time undergone repair. Among the other objects in the collection may be noticed a curious bronze panel, which represents a house or palace with castellated battlements similar to those figured on the Assyrian bas-reliefs. Several other fragments are of architectural importance—portions of a bronze altar—all of which bear strong marks of Assyrian copying.

On examining these objects the question most naturally arises as to the date to which we are to assign them, a question we are fortunately enabled to solve by means of an inscription on one of the fragments. This inscription bears the name of a monarch named Argistis, and a dedication to the god Haldis, the chief deity of the Armenian Pantheon. In the reign of the Assyrian King Shalmanesar III. (B.C. 850), the kingdom of Mannai or Van, to the north-east of Assyria, began to be a powerful opponent of the Assyrian rule, and wars were waged between the Minneans and the Assyrians. It was at this period that the Minneans adopted the cuneiform mode of writing, and a Kalak or Nimroud was then the Assyrian capital: they copied the heavy style of art of that period. But the kingdom of Van came into most direct and continuous contact with Assyria during the reigns of Sargou (B.C. 721) and his successors; and Sargou gives among his opponents the king whose name is found on one of Mr. Layard's bronzes, and we may therefore place him about B.C. 715. Mr. Layard, during his former travels in the Armenian regions, copied a number of the so-called Van inscriptions, and although a few cuneiform scholars are able to read the proper names, no one has yet deciphered the texts, although there is no doubt that they would be of great use to the history of the late dynasties of Assyria. The city of Van, from which Mr. Layard obtained these antiquities, is one of very ancient date, having certainly been in existence as early as the tenth century before the Christian era. The close connection between its foundation and Assyria is borne out by the local legend, which attributes its foundation to the Queen Semiramis, from whom it derived an ancient title of Schamiramfard. Here the Assyrian queen was said to have founded a place with luxurious gardens and streams. Here she spent the summer months among the cool and pleasant hills on the banks of Lake Van, returning to Nineveh in the winter. This legend is evidently but an echo of the true, close connection between Assyria and Armenia. The monarchs of Van style themselves in their inscriptions Kings of Mannai and Nalvic, which indicates that their rule once extended further south than the Armenian ranges. In one triumphal text of this King Argistis, Babylon is mentioned as a tributary. It was the Minneans who, in conjunction with the Medes and the Gimerreans, overthrew Nineveh in B.C. 609 and ended the Assyrian empire. Van was an important city under Persian rule, and there are inscriptions of Persian kings in its neighborhood. But it appears to have fallen into decay, and was not of much importance until the second century B.C., when the Monarch Vagharschag, the first king of the Arsacian dynasty of Armenia, rebuilt it and made it the strongest city of the empire. In the 11th century it was ceded by the family of Ardzroumis to the Greek emperors, and after a Turkish capture it was sacked by Tamerlane in A.D. 1392. We hope that Mr. Layard may find time to continue his researches in the field with which his name is so closely associated.—*Engineering and Building Times.*

ANTHROPOLOGY.

PARIS will probably contain, during the period of its great Exhibition, an unrivaled collection illustrating the science of man. The Trocadero Palace, which will be devoted to anthropology, consists of a vast central rotunda, with two wings extending in the form of a very open horseshoe. It is intended to reserve the galleries in the central pavilion for the exhibition of such objects as bear upon pure anthropology. The left wing will illustrate the ethnography of non-European peoples, and its gallery will terminate with a splendid Egyptian collection. The right wing will be devoted to an exposition of the history of art in Europe. All collectors of anthropological or archæological specimens are invited to exhibit, the committee being anxious to render the display as complete as possible.

PROFESSOR MANTEGAZZA's studies on the Papuans of New Guinea, published in the last number of his *Archivio per l'Antropologia*, will be welcomed as a valuable addition to our knowledge of these people. His paper is based on a study of the grand collection which is deposited in the National Museum of Anthropology at Florence. This collection was formed by the distinguished travelers Beccari and De Albertis, and numbers no fewer than two hundred Papuan skulls, accompanied by a rich assemblage of objects illustrating the arts of the people. The skulls described in this paper were obtained chiefly from the Misore Isles in Geelvink Bay. Page after page is occupied with tables of figures representing a large number of craniometric determinations; and the characters of the typical cranium are summed up in a technical description, which is, however, too long for transference to these columns. The general type stands very near to that of the New Caledonians and of the Fijians, and is decidedly superior to that of either the Australian, the Tasmanian, or the Negro. The variations in similar parts of the skull in different specimens suggest that these Papuans are a mixed race, but the author withholds speculation as to what ethnical elements may enter into their constitution. To illustrate the physiognomy of these people, the paper is accompanied by three photographs which are reproduced from some sent home by De Albertis. Anthropologists will anxiously look forward to the appearance of the second part of Professor Mantegazza's paper, which will deal with the psychological character of the Papuans, as deduced from a study of their arts and industries.

FIFTY years ago an English gentleman, one Mr. George Latimer, settled in the West Indies, and during a long residence in the island of Porto Rico succeeded in forming a most interesting collection of Carib antiquities. On his death the collection passed to the National Museum at Washington. Mr. Otis Mason has carefully catalogued this collection, and his work has recently been published, with illustrations, in the Smithsonian *Report*. Although the English student was familiar with Carib implements, as figured, for instance, in Mr. Stevens' *Flint Chips*, his knowledge will be greatly expanded by the wealth and variety of the specimens in the Latimer collection. Especially noteworthy are the polished celts, gracefully carved each out of a single piece of jadeite, and hafted in wooden handles. It is remarkable that the collection does not contain a single flaked or chipped implement or weapon. Most of the specimens were turned up by the plow and the hoe when new land was brought under cultivation in the island. They evidently represent a people who were, to use Dr. Morgan's nomenclature, in the "middle status of barbarism."

IN 1874 the photographic division of the United States Geological Survey of the Territories was instructed to report upon the ruins of the remarkable cliff-dwellings which are scattered over the country at the head-waters of the Rio San Juan. The report was duly published in the *Bulletin* of the survey; but, in order to convey a better notion of the character of these curious buildings than could possibly be given by means of drawings, it was determined to construct models of the principal examples. Mr. Jackson and his staff have accordingly prepared a large number of models, and have also reproduced some of the pottery and other objects which were found in the ruins. Restorations have been attempted, and hence some of the models convey to the spectator a representation of what is believed to have been the mode of life of these long-forgotten cliff-dwellers. In the spring of this year Mr. Jackson visited parts of New Mexico and Arizona, and carefully examined all the archaic remains which he could discover. This has led to the recent execution of a series of new models which represent some of the old Moqui villages.

FOUR double-page plates accompany the last part of M. Cartailhac's *Matériaux pour l'Histoire Primitive de l'Homme*. These are filled with copies of some curious figures sculptured on rocks near the Lacs des Merveilles in Switzerland. The markings represent the heads of horned cattle, spear-heads, and other weapons apparently of stone. The origin of these rock-sculptures has long been an enigma. Tradition ascribes them to Hannibal's soldiers; but then all unaccountable things in the Alps are similarly explained. Scientific folk have suggested that they may be hieroglyphic symbols; but M. Léon Clugnet, who has copied and described them in the *Matériaux*, ventures on a very simple and commonplace explanation of the mystery. He reminds us that although the sculptured rocks are difficult of access, yet the scanty herbage in the neighborhood would be sufficient at certain seasons to attract flocks of sheep and goats. The shepherds, to while away the long hours while tending the flocks, might have amused themselves by cutting these rude figures. The paucity of subjects is sufficiently explained by the monotonous life of the rough artists. Probably the marks were made with pointed implements of stone, and may date back to a pre-metal-using age.

NEARLY three thousand tumuli or *kourgans* have been opened by Prof. Ivanovski in the Votskaiia Piatina, in the province of Great Novgorod. From these ancient burial-mounds the indefatigable explorer has obtained more than ten thousand specimens. A visit to the district has enabled M. Vladimir de Mainof to publish a description of the tumuli, which has appeared in the last part of the *Matériaux*. The ethnical characters of the inhabitants of the district during the mound-building period are an unsettled question. Did they belong to the Slav race, or to the Finnish? Ivanovski inclines to the former, while Aspelin and Ahlquist take the latter view. Our author describes in the present paper some skulls from the mounds, but suspends his judgment until he shall have completed the examination of upward of two hundred crania which have been exhumed by Ivanovski. Nevertheless the craniological data already published suggest Finnish rather than Slav affinities. Moreover, the objects which have been disinterred present Oriental Finnish characters. In fact, if the people of these kourgans were not themselves Finnish, their civilization was certainly of Finnish origin.

IT is well that officers of geological surveys who are working in unfrequented districts should keep their eyes open to any prehistoric remains which may come under their notice. Mr. W. King, of the Indian Survey, has shown himself fully alive to the value of archæological observations by the notes which he has recently communicated to the Asiatic Society of Bengal. These notes describe a prehistoric burial-place which he visited in the course of his geological work, near Mungapet in the Nizam's dominions. The cemetery consists of an assemblage of about 150 stone cists, inclosed in megalithic rings, with four large monoliths in the shape of crosses. Each tomb is formed of four upright slabs of stone, with another for a covering-lid; the largest cist measuring 9½ feet in length by 9 feet in width, with a height of about 5 feet. The stone slab which forms the floor of each cist is hollowed into one or more cavities for reception of the bodies, which were probably embalmed. The surrounding circle of stones is in some cases 30 or 40 feet in diameter, and one of the crosses measures 16 feet in height. The cists and crosses are all of dressed stone, the material being the sandstone of the country. It is suggested by Mr. King that this burial-place is of pre-Aryan age, or belongs to Hindoo-Kolarian times. Ruder remains of similar style are scattered over the surrounding country, but the group of tombs which he describes is of special interest from the presence of the crosses, which is quite an exceptional feature.—*Academy.*

ARCHÆOLOGY.

SOCIETY OF BIBLICAL ARCHÆOLOGY, London, December 4, 1877. DR. S. BIRCH, President, in the Chair.

The following papers were read:—

"ON some Early Babylonian or Akkadian Antiquities," by W. St. Chad Boscawen. This paper dealt chiefly with a series of early Babylonian monuments found on the mounds of Zergul in Southern Babylonia. Chief among these were an inscribed brick and a cone, presented to the Society of Biblical Archæology by Lieutenant-Colonel Prideaux. Mr. Boscawen examined the name of the ancient city of Zergul, which was recorded on these bricks, and pointed out that the city derived its name of "the city of the great light" from a temple situated within its walls, one of the cones being dedicated to the "Lord of the wood of life," a temple to whom was erected in Zergul by a monarch named Gudea. The author showed from this and other evidence deduced from inscriptions that the primitive Akkadians used the fire-stick to kindle their temple and other fires. He then examined some of the Babylonian fire hymns and prayers, and pointed out their similarity to the Aryan ones. Various other monuments of the Chaldean king Gudea were next described, chief among which were two curious bronze statutes, now in the British Museum. These statutes were early Chaldean divinities, or priests, who were represented as wearing the horned cap so commonly figured on the gems. They were clothed in long robes, which had been richly ornamented with chasing. Kneeling on one knee, they held in their hands large cones of bronze, with the apex downward, on which were inscribed similar dedications to those on the terra-cotta cones. The author pointed out that, from the marked non-Semitic character of these faces, it was very possible that we had here representations of the primitive Akkadian population of Zergul. Lastly, Mr. Boscawen noticed a statue of black marble, bearing an inscription of King Gudea, now in the British Museum, and touched on many points relating to the civilization of the period when these monuments were erected.—"Notes upon the Assyrian Dispatch and Report Tablets," by T. G. Pinches. The author commenced his paper by stating that these tablets, on account of there being numerous other texts of greater interest, have been much neglected by Assyriologists. In spite of the difficult nature of the inscriptions, they give many very interesting facts concerning the ancient inhabitants of Assyria. It is a fact of special interest that they are not the productions of the court scribes of Nineveh, many of them seeming to have been written from dictation; they thus give us very good examples of the language of the common people. They abound in unusual words, and there are also peculiarities of pronunciation and accentuation. Most of them are very carefully written, and from this circumstance it is very improbable that we have here the original documents—at least in the case of the dispatch tablets. It must often have been impossible, when campaigning, to make use of the apparatus for baking the clay, and when baked they were also liable to be broken in transit; it is therefore probable that papyrus was used instead of clay. This supposition is also strengthened by the appearance on the bas-reliefs of two scribes writing, the one upon a clay tablet and the other upon some flexible material, probably papyrus. The document, having been written and sent to the king, was copied by the court scribes and placed in the royal library at Nineveh. Most of the peculiarities of these inscriptions consist in doubling letters to indicate accent, and the assimilation of sounds to a greater extent than is found in other inscriptions. One phrase, found on a letter-tablet, may be noted as being very peculiar—viz., *sepâ ana sepâ*, lit., "feet to feet," the signification of which, as shown by the context, is "keeping step together"—*i.e.*, "with one consent." The remainder of the paper was occupied by specimens of translations of these tablets, with comments. One, written in the reign of Esarhaddon, contains summaries of dispatches received by an Assyrian officer, evidently the governor of a large province, from certain governors under him. The greater part of these summaries refers to the movements of the king of Akkad, who was at war with Assyria at that time. Two tablets referring to the revolt, overthrow, and death of Bel-Basa, king of a small state situated in the marshes of Babylonia, named Gambulu, and the capture and trial of his son for being in league with other princes to raise a rebellion, show how these tablets may sometimes fill out the details of the historical inscriptions very considerably. The paper closed with a translation of a tablet relating to the removal of some statues of gods to a new shrine, a ceremony which seems to have been performed with great rejoicing. The writer of the inscription then goes on to inform the king that certain men, whose names are not given, had refused to give the customary offerings of wine, etc., to the temple, evidently, of the forementioned gods. The paper was accompanied with interlineated copies of all the text described.—"On the Mythology of Pasht and the Cat in Egypt and in Prehistoric Times," by Hyde Clarke. —*Academy.*

[NATURE.]

SCIENCE NOTES.

A GIGANTIC PENDULUM.—Preparations are being made at the Champ de Mars, Paris, for executing Foucault's pendulum experiments on an enlarged scale. His apparatus was suspended in 1851 under the dome of the Pantheon. It was in operation for a long while, and removed only when the building was transformed into a church after the *coup d'état* in 1852. The weight of the pendulum will be 300 kilogrammes, and it will oscillate at the end of an iron wire from 65 to 70 meters long. Thus a special construction will be required for its suspension. The pendulum will be suspended above a grooved pipe, which will move freely on an axis in its center. The pendulum in oscillating will displace this pipe, which will remain, like the pendulum itself, fixed in space, in reference to the constellations. Underneath the pendulum will be arranged a large terrestrial globe, from 25 to 30 meters in diameter. This globe, resting on the ground, will necessarily follow with the spectators the movement of the earth. The pipe, on the contrary, supported by a pivot at the extremity of the axis, will carry large indexes, which will appear to be displaced with it. The globe, which will represent the earth, having a considerable volume, the movement of these indexes will be visible; it will render tangible in some degree to the least attentive the rotation of the planet on its axis.

REMARKABLE ARTESIAN WELL.—The deepest artesian well in the world is being bored at Pesth, and has reached already a depth of 951 meters. The well at Paris, which measures 547 meters, has hitherto been the first. The work is undertaken by the brothers Zsigmondy, partially at the expense of the city, which has granted £40,000 for the purpose, with the intention of obtaining an unlimited supply of warm water for the municipal establishments and public baths. A temperature of 161° F. is shown by the water at present issuing from the well, and the work will be prosecuted until water of 178° is obtained. About 175,000 gallons of warm water stream out daily, rising to a height of 35 feet. This amount will not only supply all the wants of the city, but convert the surrounding region into a tropical garden. Since last June the boring has penetrated through 200 feet of dolomite. The preceding strata have supplied a number of interesting facts to the geologist, which have been recorded from time to time in the Hungarian Academy of Sciences. Among some of the ingenious engineering devices invented during the course of the boring are especially noteworthy the arrangements for driving in nails at the enormous depth mentioned above, for pulling them out (with magnets), for cutting off and pulling up broken tubes, and, above all, a valuable mechanical apparatus by means of which the water rising from the well is used as a motive power, driving the drills at a rate of speed double that previously imparted from the mouth of the well.

PROGRESS OF THE CHANNEL TUNNEL.—The preliminary works for boring the British Channel Tunnel are being prosecuted with very great activity at Sangate. A shaft has been sunk to a depth of 100 meters, and the experimental gallery has been commenced. It is to be continued for a kilometer under the sea. If no obstacle is met with the work will be continued without any further delay. Two powerful pumps have been established for elevating the water, which, of course, filters in in large quantity.

APPLIANCES FOR VOLUMETRIC ANALYSIS.

THERE are many calculations in connection with photography which render necessary the determination to a degree of some nicety the exact quantity of some particular substance in a small quantity of a given liquid; or it may be that the purity of one of the numerous salts employed is suspected, and in order to arrive at a satisfactory conclusion on the point it is necessary to resort to volumetric analysis. But how many photographers are in possession of even the crudest appliances for performing such an operation? We frequently hear the recommendation to test the strength of the bath by volumetric analysis in preference to employing the argentometer; and we venture to say that, in nine cases out of ten, where that recommendation is adopted the operation is performed in such a manner and with such appliances as to render the accuracy of the result, to say the least, problematical.

As a matter of fact, we not long ago met with an instance in point. An amateur having got into trouble with his printing bath put it through a course of "doctoring," and before again taking it into use was desirous of ascertaining its strength. The argentometer was out of the question, as it contained originally, in addition to the silver, both nitrate of soda and sugar, to say nothing of the fresh salts introduced in the ordinary course of working. Accordingly he proceeded to test it by the volumetric method, with the somewhat surprising result that, though it had sensitized many sheets of paper, it was three or four grains richer in silver in each ounce than when freshly made, and that without a proportionate decrease in bulk, which would account for it on the score of evaporation. It proved that our friend had proceeded in the first place to make a solution of chloride of sodium of so many grains to the ounce, had tested a measured quantity of the bath by dropping into it, by means of a pipette, the necessary quantity of chloride to precipitate the whole of the silver, and had then calculated that so many *minims* of solution used, containing such a quantity of salt, represented so many grains of silver nitrate.

Theoretically there is, of course, no fault to be found with such a course, but it is the mode in which it is put in practice which is to blame. First, as regards the volumetric solution: It will be found in practice that the ordinary one and two ounce graduated measures are wholly unreliable for such purposes, as the graduation is frequently most carelessly performed. Of three or four in our possession at the present time no two agree perfectly at the one ounce mark. We may add to this the extreme difficulty, if not impossibility, of reading off the measurements with sufficient accuracy for even an approximation to truth. But the gravest error in the case we speak of is the acceptance of the *drops* delivered by the pipette as *minims*. We have never yet been able either to make or obtain a pipette which would give a correct result in such a calculation unless it were first ascertained how many of the drops delivered by it go to make a drachm. If such a knowledge be obtained, the quantity of solution actually used may be calculated with more success; but the size of the drops will vary with the solution employed. In practice it will be found that the majority of such tubes deliver drops measuring less than a minim.

At a cost of a few shillings may be obtained a properly-graduated *burette* or alkalimeter; but, as the occasions on which such instruments are required are comparatively few and far between with most photographers, we do not counsel an investment which many would hesitate to make. In lieu thereof we propose describing how an efficient substitute may be made at an outlay of a few pence. Though possibly the strictest accuracy will not be attainable in all cases, the instrument will be found fully equal to the task of testing the negative or printing bath; while if carefully made and used, it may be applied to such delicate operations as the determination of the excess of silver or bromide in emulsions, or the calculation of the combining equivalents of those salts.

In the first place, procure a piece of hard glass tubing of about half an inch internal bore. The length will depend upon the number of grains' capacity it is intended to be; if one thousand, it will require to be about eighteen inches. A tube of this length and bore may be obtained for twopence or threepence. Next we have to decide upon what form of *burette* to adopt. The best and most convenient, as well as the easiest in construction, is that known as Mohr's, which consists of a tube of the dimensions given above, one end of which is drawn out narrower, connected by means of a short piece of india-rubber tubing with a thinner tube drawn to a fine point. A spring clip is fixed upon the rubber tube, midway between the two glass ones, so as to pinch it and prevent the passage of any liquid until the pressure is taken off by loosening the clip. The instrument is suspended in a perpendicular position, in such a manner that the vessel containing the solution to be tested may be placed beneath it to receive its contents, which are delivered in small quantities at a time by releasing the clip.

The instrument we have in use is a slight modification of the above, though identical in principle, and we will describe its construction. We may premise that those of our readers who desire to make one of these instruments, but are not sufficiently practiced in glass working to venture upon it, may get the tubes drawn or closed by a glass-blower or maker of chemical apparatus for a few pence, reserving the graduation and finishing of the article as their own share of the work.

Having procured a piece of tube of the proper dimensions, proceed, with the aid of a Bunsen's burner, to soften and draw out one end to a point, like a dropping-tube. Let the taper of this point be as obtuse as it can be made compatibly with symmetry and efficiency in dropping. The opposite end of the tube is raised to a red heat to make the edge smooth and regular and to strengthen it. The open end is then fitted with a good, sound cork, through which is passed a piece of thin glass tube the thickness of a quill, upon which to fix the rubber tube and clip. In our own instrument the quill tube is bent in the form of a siphon or ⊓, so that the india-rubber tube and clip, when attached, hang parallel with the main tube, and are thus brought more easily within reach of the operator. All that now remains is to graduate the instrument.

Another form, not quite so convenient in some respects, is made as follows:—Instead of drawing the tube to a point, one end is closed altogether; the other end is heated until quite soft, then, with a piece of stout iron wire previously heated, press gently round the interior edge of the orifice, so as to widen it slightly. This done, press the iron firmly but gently against one side, when the edge will be drawn over, and form a lip from which to drop the contents of the tube. When cold it is ready for graduation.

This operation, though requiring care, presents no difficulty; the object to be attained is to divide the tube into one hundred equal parts, or, more correctly speaking, to mark off one hundred equal degrees, not necessarily filling the whole of the tube. This is done by weighing into the tube successive quantities of some liquid to form the principal divisions or tenths, and these may be subdivided by means of dividing compasses for the one-hundredths. We proceed, then, to suspend the tube by means of a loop of twine or thin wire to one arm of an accurate balance, the scale pan being removed; take care that it hangs properly, for if a knot in the twine or a bend in the wire throw it out of position, inaccuracy will result. Before counterpoising the tube we must fix what we may term the "zero"—that is, the point at which the scale is to commence; this is necessary on account of the irregular shape of the extreme lower end of the tube. In the first one described the zero point may be fixed very slightly above the commencement of the taper, and a mark made with a fine file. In the other form it is fixed in the following manner:—Fill the tube with water; pour out the water and hold the tube, orifice downward, for five or ten seconds, to allow it to drain; then reverse it and allow it to remain in a perpendicular position for a minute or two. It will then be seen that the water retained on the interior surface of the tube has accumulated to a depth of a quarter or perhaps three-eighths of an inch, at which point make a mark with the file.

Drop into the tube sufficient water to reach zero, suspend it to the balance, and counterpoise carefully. Now, suppose the tube to contain one thousand grain measures, place on the opposite pan of the scale one hundred grains, and balance it by adding the same weight of water to the tube, marking the point to which it reaches by a slight *touch* of the file; then proceed with the second hundred, and so on till the thousand is reached. With a pair of compasses try each of the spaces, and if they be all equal let the file marks be put in distinctly about a quarter of an inch long. The subdivisions are made by setting off on a piece of paper one of the spaces of a hundred grain measures, which is accurately divided by means of the dividing compasses into tenths. With this as a guide each of the spaces on the tubes is now marked off into degrees, the mark made by the file being in this case little more than a touch, in order that the principal divisions may be readily distinguishable. The fifth division in each space may be made a little more prominent.

The instrument is now complete, and if the directions have been followed carefully it is capable of working to the one-tenth of a grain without difficulty. We have found it useful in determining the combining equivalents of samples of the bromides of cadmium and zinc, for which purpose it is well adapted. The second form described also supplies a ready means of taking the specific gravities of ether and alcohol, or any liquids it may be desired to test. We may conclude by saying that the two instruments we have now in use have cost us together less than one shilling.—*British Journal of Photography.*

ACCORDING to a Belgian photographic journal Herr Zinno has discovered a new way of preparing oxygen in large quantities. Baric peroxide and potassic permanganate are placed in water and allowed to act upon one another, the result being that 200 cubic centimeters of oxygen are evolved from every gramme of the mixed substances.

IMPROVEMENT IN PHOTO-ENGRAVING.

AT a recent meeting of the Photographic Society of France, M. Gillot made a communication on chemical engraving. After speaking of the weak points connected with the present processes of photo-engraving, he said that when an artist should be able, without the aid of an engraver, to turn out work imitating, more or less, wood engraving, but with all the fine lines of a copper plate, the end sought for would be accomplished. He (M. Gillot) then proceeded to give his own method of procedure as follows:—The drawing is made on a Bristol board, coated and prepared with white lead; the artist takes a small "*malette*" and rolls it upon his drawing, to form the "*tailles en creux.*" The *malette* can be applied in any desired direction. We have then a relief wherever the *malette* has passed. By rolling the *malette* horizontally and vertically hollow lines are made, crossing one another, and there remains a square point. When these operations are completed, draw with a lead pencil or a lithographic pencil (very hard). The pencil in passing over the paper can only touch the minute projecting points, while the "*tailles en creux*" produced by the *malette* remain white. By examining a *cliché* attentively a judgment can be formed of the progress in this process. For greater facility the drawing can be made larger, and reduction by photography to the right size imparts to the lines of the drawing and the work of the *malette* more fineness, and there only then remains to make the photograving by the ordinary means we employ.

A patent has been taken out by M. Gillot. The prints were illustrations of *Life in London and Paris*, after Adr. Marie. They had all the appearance of being printed from copper plates, and were admirable specimens of the progress made by Gillot et fils.

LIQUEFACTION OF OXYGEN.

ON the 22d of December, 1877, oxygen was for the first time liquefied by M. Raoul Pictet.

Little more than a century has elapsed since the first discovery of this gas (by Priestley, in 1774), and vast has been the progress of science since that time. The whole modern structure of chemistry has been raised, and photography was then undreamed of. Gases at one time were looked upon as uncondensable vapors; but, within the century, first one and then another has given way to the persevering efforts of experimentalists, till at last the number of incompressible gases, by the liquefying of nitric oxide about a month ago by M. Cailletet, was reduced to three—oxygen, nitrogen, and hydrogen.

Now that oxygen has succumbed two only remain unliquefied; and we may hope to look forward to the time when sufficient oxygen to make an enlargement by, or even to suffice for an evening's entertainment with a magic lantern, may be condensed sufficiently to be able to be carried in one's pocket.

We do not, of course, mean that the new process will enable us to obtain cheap liquid oxygen; but it generally happens in commerce that, whenever a substance has been made, readier and cheaper means are discovered for producing it in quantity. For example, we know that hyposulphite of soda can now be purchased at less per hundredweight than it cost per pound when its use in photography was first shown, and liquid sulphurous acid gas—at one time a great chemical curiosity—is a recognized article of commerce.

There are many other similar cases which we need not here repeat, and for this reason we are not without hope that liquid oxygen may be one of the usual *impedimenta* of the future magic lantern exhibitor.

We have said how, by degrees, the number of incompressible gases has been gradually diminishing. We owe to the illustrious Faraday the reduction to the liquid state of all known gases except the four we have named, with carbonic oxide and marsh gas. The method he employed was a combination of enormous pressure and extreme cold, further enhancement of the effects being produced by evaporation *in vacuo* of the cooling agent, a temperature of —110 being obtained with the air pump, —76·6 in the open air. The extreme pressure was 50 atmospheres.

Since that time Professor Andrews has made important contributions to this branch of science; but even he did not succeed in liquefying either atmospheric air, oxygen, hydrogen, carbonic oxide, or nitric oxide with a cooling bath of liquid carbonic acid and ether as a temperature reducer, and at such enormous pressure as reduced their volumes respectively to $\frac{1}{42}$, $\frac{1}{34}$, $\frac{1}{36}$, $\frac{1}{15}$, and $\frac{1}{36}$ of their bulk.

It is remarkable that under the method so recently successful with oxygen neither the pressure nor the temperature of the cooling bath was so extreme as those we have just recorded, and hence we are quite justified in hoping that still improved methods of obtaining liquid oxygen may be discovered, for the incentive will be enormous now that it is known that the feat can be accomplished. It would be impossible to give a list of all the uses to which such a substance could be applied.

The process adopted by M. Raoul Pictet was designed rather differently from those usually employed, and is remarkably ingenious. The oxygen is made in a large generator of immense strength, so as to resist any pressure it would be subjected to, and is in form somewhat like a large shelf. The cooling agent is carbonic acid, which is liquefied under a pressure of four to six atmospheres and a temperature of 65°. It is conducted in this liquid state into a tube four meters long, and is then solidified by means of a vacuum produced by two combined pumps. Attached to the oxygen generator is a tube, narrower than the one named; it is passed through the tube of frozen carbonic acid, and the apparatus is then ready for use. The oxygen, which has been kept confined in the vessel that generated it (thus allowing a pressure of 800 atmospheres, if necessary), has had its temperature reduced so as to obtain the utmost cold. When the connection is complete the oxygen is turned on. The conditions thus carried out on the day named were—cold compressed oxygen ready to expand, and so produce a still lower temperature, passing through an extremely cold tube. When it reached the orifice it emerged as a jet of liquid, and the most remarkable product of modern ingenuity and perseverance was obtained.

The pressure was by no means great nor so extreme as had been obtained by other experimentalists with no success, as it only reached three hundred atmospheres.

The temperature is not given in the account which has reached us, but it must have been remarkably low, for the carbonic acid was liquefied at 65° and then frozen in a vacuum, which would probably give the temperature Faraday obtained, as above stated; and, finally, the expansion under the atmospheric pressure only must have produced a still further reduction of temperature.—*British Journal of Photography.*

LECTURES ON PARALYSIS AND CONVULSIONS AS EFFECTS OF ORGANIC DISEASE OF THE BRAIN.

Recently Delivered at Bellevue Hospital Medical College.

By C. E. BROWN-SEQUARD, M.D., ETC.

LECTURE VI.

GENTLEMEN:—In the last lecture I pointed out to you the symptoms that are generally found when the paralysis occurs from disease in the cerebellum. To-day I have to conclude with what relates to that question. You may remember that I said there was very frequently in such cases a disorder in the movements of the body. I have characterized them as being similar to what is observed in a drunken man. One observer, taking into account the experiments of Ferrier, endeavored to show that the centers for the movements of the eyes are located in the cerebellum. He thought that if disease in the cerebellum produced disordered movement it was due to lack of power in the eye; the movements of the eye become irregular and disordered, and a man who sees objects continually shaking before him has disorder in his movements. This peculiar condition of disordered movements can not be explained in this way. If it were due to such a cause it would cease as soon as the eyes were closed, for then the impression of the shaking of objects would be lost, and consequently be without effect. In most cases there can not be such an explanation, as there is no such pretended relation. These conclusions as to the explanation of the disorder in movements have been arrived at from Ferrier's experiments on the electrization of the cerebellum in animals.

Ferrier has not paid attention to a fact which always occurs in experiments of this kind. The movements seen in electrization are due to an irritation carried from the point to which the stimulus is applied. The action is caused in a reflex manner. The same sort of thing occurs when the sole of the foot is tickled. When we irritate that part certain muscular movements occur in the face, but we do not conclude from that fact that the center for those movements is situated in the sole of the foot. The same reasoning leads us to deny that because galvanism of a certain portion of the cerebellum causes movements in the eyes, that the center for their movements is situated there.

In order to establish the existence of a center for special actions, we should be able to show that not only galvanism but all other modes of irritation or excitation will produce the same action, and furthermore when the brain is destroyed or the part is taken away with the knife we should get a cessation of the movements.

I have found in six or seven hundred cases of cerebellar disease no trouble whatever with the eye; only in a trifling number of cases is there trouble with the eye. Cases vary greatly; in some there is spasm of the recti muscles, in others there is something else, and there are a great many kinds of difficulty. It is certain, however, that a peculiar disorder of movements is frequently observed in disease of the cerebellum.

There are two other peculiar features observed as regards disorder of movements in disease of the cerebellum. These are just the opposite of each other, one being a tendency to run forward, and the other a tendency to run backward. There are cases reported of tubercles situated in the center of the cerebellum in one of which the patient had a tendency to run forward, and in the other there was a tendency to run backward. Now, you can not in one individual locate in that spot the center for forward movements, and in the other the center for backward movements in the same place, and as, besides, in disease of the same part of the brain a variety of symptoms may occur, you can not say that there exist centers for forward, or backward, or side movements.

So it is with the rotatory or circular movements. You can find all of these peculiar aberrations of movement in disease of other parts of the brain, although, it is true, some of them are found most frequently in disease of the cerebellum. The rotatory movement occurs more frequently in disease of the pons Varolii where the crus cerebelli enters it, or in the crus cerebri. These portions have more power of producing this movement than the cerebellum. Disease of the supra-renal capsule has been known to produce this description of movement. Disease of the auditory nerve with or without organic disease of the brain has been known to produce it, as in the celebrated case of the Duke of Wellington. He was suffering from some trouble with the ear, and a quack injected into it a solution of nitrate of silver. The next day he was seized with this affection and continued to roll round and round in his bed.

But to continue with what I have to say of the symptoms that coexist with disease in the cerebellum. There is a fact of considerable interest concerning the sexual organs. It has been said that the cerebellum is the center for the sexual apparatus. It is certainly true that in some cases of disease we find a loss of sexual power, but we may, on the other hand, see exactly the reverse of this condition present. An inflammation in the center of the cerebellum may cause either loss or increase of the sexual power. The conclusion that there is no relation between the sexual power and the cerebellum comes out even more clearly when you see that no change whatever may appear in this function when there is extensive disease of the cerebellum.

In one of the most remarkable cases that I know of, of disease of the cerebellum, that recorded by Dr. Combette, there was no trace of disorder of movements or inability to stand or walk. In this case the disease was located in the cerebellum and its attachments. There was no loss of sexual appetite, but, on the other hand, an enormous increase. If the organ were in connection with or had control of the sexual apparatus something quite different should have occurred. The patient was a young girl who was intensely addicted to masturbation. The result was not due to an irritation of the organ, as there was no organ there to be irritated. We can not say that the symptom was due to such a cause, as the cerebellum was completely absent. The views, then, as regards the presiding power of the cerebellum over the sexual apparatus can not be entertained.

Another most important point relates to the paralysis itself. If the cerebellum has any particular function it is the organ that serves for the production of nerve force. The only thing that is at all constant in disease of this organ is a diminution of the strength. This loss of strength exists in all parts of the body, whether the disease is situated in one half or the other of the cerebellum, or in the middle.

The variety of paralyses that occur in disease of the cerebellum is extremely great. There is no doubt, however, that in most cases there is a localized paralysis. Paralysis may be due in some of these cases to pressure on the pons Varolii exerted by the lesion in the cerebellum. Almost invariably in these cases the paralysis is on the opposite side of the body. We find such results particularly when the lesion in the cerebellum is of such a nature as to cause pressure, as a hæmorrhage or a tumor of considerable size that presses on the pons Varolii. In such cases the paralysis is due in reality to disease of the pons Varolii and only apparently to the disease in the cerebellum.

Sometimes paralytic symptoms appear in cases where there is but very limited disease in the cerebellum, as a slight softening. In such cases paralysis can not be due to pressure on the pons Varolii, and there is no doubt whatever that paralysis may appear where there is no degree of pressure whatsoever.

There may be, in rare instances, paralysis of the face, or the tongue, or the whole body, but, as a rule, in hemiplegia allied with disease of the cerebellum there is no paralysis of the tongue or of the face. In these facts lie the principal points of diagnosis. If a patient be suddenly struck down with apoplexy and has a strong hæmorrhage, if he have hemiplegia, difficulty in breathing, coma, and loss of consciousness, we have here the symptoms usually occurring in hæmorrhage in some part of the eucephalon. If we find no paralysis of the face or tongue, and when the patient recovers from the first effects of the stroke he has vomiting, amaurosis, etc., we may usually consider that the hæmorrhage has occurred in the cerebellum. When the patient has recovered sufficiently to get up, and when he walks we notice that, besides his hemiplegia, he has disorder of the movements, we are still further led to think that the disease is situated in the cerebellum.

Professor Andral has pointed out, perhaps more forcibly than any one else, that disease frequently coexists on one side of the brain and on the other side of the cerebellum. In such cases the paralysis that occurs is almost always situated on the side of the body in which the disease located in the brain would produce it, viz., usually the opposite. This is almost always the case when there is a lesion on one side of the brain and the other side of the cerebellum. There is an exception sometimes when we find tubercles scattered on the right side of the brain and the left side of the cerebellum, and in some of these cases we have paralysis on the right side of the body, contrary to Andral's rule.

Another feature is extremely interesting. When atrophy is found consequent on disease of the brain, we almost always find some in the cerebellum on the opposite side. We shall have to pay more attention to this in the future than in the past, as much that will prove of interest will be found in this fact of connection.

Now let us pass to the crura cerebri, parts above the pons Varolii at the base of the brain. They are composed of a great nest of fibers going through them to enter into the corpora striata and optic thalami, or to go directly to the convolutions of the brain. This part is certainly full of interest. It is quite certain that the crus on each side is, according to the prevalent theory, the only bond establishing connection between the same side of the brain and the opposite side of the body. As everything is narrowed down, then, to one particular location, what pathology shows us in regard to disease of this portion is far more important than what relates to other parts. There is no possibility of escaping from the conclusions to be drawn from these facts. All the fibers serving for voluntary motion pass here, those from the right side of the brain in the right crus, and those from the left side of the brain in the left crus. This is in accordance with the generally admitted theories.

If these theories were right, when there is disease in a small part of the crus, striking only a few fibers of the many that compose it, say the outside fibers, the paralysis should be limited accordingly. If these fibers are really what they are imagined to be, going straight to the muscles after having passed through cells in the medulla oblongata and spinal cord, we should always see the paralysis limited entirely to certain muscles. It might be paralysis of the arm or leg, or only a few muscles of the arm or leg might be involved. Now such is not the case at all. There are a great many cases of disease located in the crus and having destroyed the fibers in different parts. A paralysis, if it exists, should be seen in those muscles receiving their nerves from the particular part of the crus that is the seat of the disease, and chiefly on the opposite side of the body. In by far the vast majority of cases the paralysis is more extensive than it ought to be, taking into consideration the extent of the lesion. You may find paralysis of one arm or of one leg only, from disease in the crus cerebri, but do not therefore believe that any particular fibers are destroyed, as we may find the same paralysis of the arm alone when the disease is elsewhere in the crus, or even in the whole of the crus. There is no connection between the seat and extent of the paralysis and the location and limit of the lesion in the crus.

There are cases where there is no paralysis at all following disease in the crus cerebri, as in the case of abscess of Jackson of Boston. There are cases where the whole of the crus has been destroyed and there has been a complete absence of marked paralysis. Still more, there are cases—four to my knowledge, one by Mason—in which disease in the crus cerebri produced paralysis on the corresponding side of the body. So that in this organ as well as in other parts of the brain we see facts that are entirely inconsistent with the old views. We see no paralysis where there ought to be paralysis, or we see paralysis where it ought not to exist, or we see paralysis on the wrong side of the body, although it ought always to be on the side of the body opposite to the side of the brain in which the lesion exists, according to the old theories.

There are five cases to my knowledge in which both crura cerebri were destroyed without giving rise to any marked paralysis.

From an examination of all these facts you must be led to admit what I have already said, that very few fibers are necessary to establish the connection between the will power and the muscles.

The symptoms of disease in the crus cerebri are quite interesting to study. The third pair of nerves, which moves a great many muscles of the eye, is affected almost necessarily in disease of the crus cerebri, unless the disease is situated in the back part. Dilatation of the pupil results as a consequence of paralysis of the constrictor muscle. There is also strabismus, owing to the persistent action of the sixth pair of nerves. In a considerable number of cases there is diplopia. There is paralysis of the elevator of the eyelid which is innervated by a branch of the third pair, and so we have ptosis. So you generally find ptosis, strabismus, diplopia, dilatation of the pupil, etc., existing when the disease is situated in the crus cerebri, and these points will help you in the diagnosis.

If the disease is situated in the back part of the crus cerebri the third nerve may escape, and then these symptoms will be wanting.

It has been supposed that the conductors of sensation likewise in going to the brain pass through the crura cerebri. This idea is radically false, as they may be destroyed without any loss of sensation. In one case hyperæsthesia occurred.

There are some other features which may lead you to the diagnosis of disease in this place. It is in the neighborhood of the passage of the fibers of the optic nerve, and so you may get derangement of vision. Where the tubercula quadrigemina are involved you frequently see amaurosis. In three or four cases I have seen hemiopia. From these symptoms you may have means of diagnosis in many cases where the disease is in the crus cerebri on either one or the other side.

The tubercula quadrigemina are frequently injured when the disease is situated in the crus; and they have been considered as centers for vision. They have, certainly, a power over vision; but they may both be diseased without any amaurosis, or one may be diseased alone and produce amaurosis in both eyes. There is then no necessary connection between them and the power of vision, but in the majority of cases we are able to say that when they are diseased we get certain changes in the power of vision. Fortunately, by a complete analysis of the symptoms occurring in brain disease we can often come to a correct diagnosis.

Disorder of movements may exist when the tubercula quadrigemina are diseased, the same as occurs in disease of the cerebellum, but in this case the symptom is usually less marked. When the eyes are closed the patient can not stand on one foot. We also find this condition present in disease of other parts, but more frequently it is due to disease here. This fact led Cocks and other physiologists lately to conclude that the tubercula quadrigemina were centers for the muscular sense. This is not so, as in many cases of disease of these organs there is no lack of the balancing power.

To pass now to other parts. There are two large ganglia, or rather part of one and the whole of another, that protrude into the lateral ventricles. One of these is the corpus striatum, which consists of two parts, the intra-ventricular and the extra-ventricular. They had always been considered as voluntary motor centers up to the time of the experiments of Fritsch and Hitzig, who have thrown physicians into the belief that the centers are located in the convolutions. Todd, Carpenter, and most others look on the corpora striata as voluntary motors centers, but here again I am obliged to dissent from these accepted views. I now speak of the intra-ventricular portion of the ganglion. Disease here, if the part were, as is believed, employed in moving the muscles, if it produced irritation, would cause convulsions to be manifested. Now, the truth is that irritation of no other part of the brain has so little power of producing convulsions. This is a decisive fact that shows that it is not a voluntary motor center. It is said to be in connection with other parts which when excited are supposed to give rise to convulsions. According to recent views it has not been stripped of its power as a center. It is supposed to be a place of passage for the voluntary motor fibers where they acquire new strength, being in connection with new cells which add fresh power to their functional activity.

In reality we find cases of destruction of the corpus striatum without any paralysis at all, or at least without any marked paralysis. There is no relation as regards the duration, extent, and degree of the paralysis and the lesion in the corpus striatum from which it resulted. There are cases in which the disease was exceedingly slight and limited to a minute part of this portion of the brain, with, however, a persistent paralysis up to the time of death, and, moreover, of a severe character. The facts observed are then in decided opposition to the theory.

Hughlings Jackson holds very properly that one small part of this portion of the brain could alone perform the functions of the whole organ. He knew very well that a great portion of it could be destroyed, and that the function might yet remain; but when we find *all* of it destroyed, and still no paralysis or loss of function, why then there is an end to the theory.

Still more. We find disease occupying the intra-ventricular portions of both corpora striata without any paralysis. There is not one such case alone, but a great many like cases.

The corpora striata have no specific signs by means of which we can recognize the locality of the lesion, but we have some signs by which we can suspect its presence there. Hæmorrhage here is by far more frequent than in any other part of the brain, except, perhaps, in the optic thalami. There is also another exception to this generality, but perhaps it can hardly be called an exception, and that is that it is also almost as frequent between these two ganglia, the corpora striata and the optic thalami. That peculiar condition that Charcot described as miliary aneurism is extremely common in the blood-vessels in this location, and this is the cause of the frequency of hæmorrhage in this location—that is, in the corpora striata and optic thalami, and between the two ganglia.

If you have paralysis of one side of the body and symptoms of hæmorrhage in the brain, in this mere fact alone there is a supposition that the disease is situated in this region. Other symptoms of disease in the brain, such as paralysis of the third pair of nerves, the existence of amaurosis, symptoms in which the patient shows a tendency to go round and round, or forward, backward, or sideways, or execute particular movements, are by far less frequent when the disease is situated in the corpora striata than they are when the disease is situated in other parts. Vomiting occurs less frequently in disease here. There may be hyperæsthesia in many instances. By passing in review all the symptoms known to be more frequent in disease of the base of the brain, and knowing that a lesion here is not so apt to produce these symptoms, we may most often come to the right conclusion; especially will this be the case if there are no convulsions.

This leads me to speak of the optic thalami, disease in which will produce convulsions very frequently. It may also cause paralysis; and here again we come into conflict with the generally accepted views regarding the physiology of this organ. According to these theories, it is not considered as assisting in voluntary movements, but paralysis comes on just as frequently from disease here as from disease in the corpus striatum or in other parts. These facts are highly in favor of the views I have given you, and decidedly against the view that paralysis arises from the destruction of centers or conductors.

In disease in the optic thalamus there is a great change in the reflex faculty in the limbs when they are paralyzed, or even when they are not much or not at all paralyzed. It disappears entirely, or is much diminished, or just the contrary—there may be a condition in which the reflex faculty is increased.

There is still another feature of interest. There is often paralysis of the blood-vessels on the opposite side when the disease is situated in the optic thalamus. Not that I consider the optic thalamus as a center for the vaso-motor sys-

tem, but nevertheless the clinical fact exists. There is a dilatation of the blood-vessels and a heightened temperature of the part. This is the reverse of what you usually find in disease of the pons Varolii, in which latter case the limbs of the opposite side are found to be colder.

The optic thalamus is certainly a most interesting organ, and I wish I could dwell upon it more at length. There are few that are so extremely interesting. Very frequently disease here is the cause of amaurosis. Still more, there may be loss of the senses on one side, generally on the opposite side, very similar to the condition produced by division of the trigeminal nerve, as described by Magendie. The loss of senses is slowly produced, generally on the opposite side, and it differs from division of the trigeminal in that respect.

What is more remarkable still, we have an alteration in the structures of the eye. This has occurred in two cases to my knowledge, and I dare say it has done so in more. In these cases the trigeminal nerve was apparently healthy, so that there is, then, a great resemblance between its properties and those of the optic thalamus. It has been considered as the center of sensation, but many new observers have given up the views of Todd and Carpenter. In the neighborhood but not inside of the optic thalamus is the channel of passage of the fibers serving for the perception of sensation. These fibers go to the posterior lobes of the brain, but we very frequently find destruction of the posterior lobes without any anæsthesia.

We will pass now to another part of the brain, that is, the radiation of the fibers to the convolutions on the external surface. This part constitutes the centrum ovale. Disease in this portion of the cerebral lobes can produce paralysis, and the paralysis may be just as great as the paralysis produced by disease anywhere else in the brain; and there is this remarkable fact, that the disease may be situated in the most distant and distinct parts, and still give rise to the same kind of paralysis. Disease in the anterior, middle, or posterior lobes can produce paralysis.

Disease in any part can produce complete paralysis on the opposite side of the body. If the disease here is limited in extent can it be that all of the fibers are destroyed? Where the paralysis is complete and the causal lesion is limited, the facts cannot be reconciled. In such a case the paralysis should be slight or local, but I repeat that complete, persistent paralysis is often present.

In the cases of Porta and others all of this portion of the brain has been destroyed without any paralysis at all.

There follows necessarily also in the examination of these facts a series of proofs against the views generally admitted. Paralysis or convulsions may be on the corresponding side to the lesion, or on the opposite, but in one out of every three hundred cases the paralysis will be on the same side. Not so, however, with convulsions. You will find them as frequently on one side as on the other when only the white fibers are diseased. Paralysis can not, then, be owing to a destruction of fibers conducting the impulses from the will power to the muscles.

PHYSIOLOGY.

On Vaso-motor Nerves.—Since Goltz first demonstrated the existence of fibers in the sciatic nerve of the dog, whose stimulation causes the blood-vessels in the corresponding hind-paw to become relaxed, his experiments have been repeated and varied by other inquirers. The presence of two sets of fibers, vaso constrictor and vaso-dilator, in the nerve-trunk has been generally recognized; and the latter have been said to differ from the former in being more easily thrown into action, less prone to undergo degeneration when they have been cut across, and peculiarly susceptible to rhythmic stimulation. Bernstein has recently traveled over the ground once more (*Pflüger's Archiv*, xv., 12), confirming all the statements originally put forth by Goltz, and refuting certain objections which have been urged against them. The alleged peculiarities in the behavior of the vaso-dilator fibers he found to be by no means essential, relative coolness of the hind-paw (usually produced by immersion in a bath) being the sole condition requisite for the development of a great rise of temperature on the application of any kind or degree of stimulus to the peripheral end of the recently divided sciatic. He set himself, further, to prove that the rise of temperature is really due to the relaxation of the blood-vessels, and not to any local exaggeration of metabolic processes, induced by hypothetical "thermic" or "trophic" nerve-fibers. This was done by substituting direct measurement of the quantity of blood passing through the limb in unit of time under varying conditions of innervation for the use of the thermometer. Bernstein is quite alive to the probability that the relaxed state of the vessels is really brought about by an inhibitory influence of the so-called "vaso-dilator" fibers on local ganglionic centers presiding over the tonus of the arterioles; he does not, however, consider it advisable to adopt this hypothesis without reserve so long as the existence of such local vaso-motor centers has not been anatomically demonstrated.

Mechanism of Death from Splenic Fever.—That the symptoms of this disease are due to the growth and multiplication of the *Bacillus anthracis* in the blood of the infected animal is now pretty generally if not universally admitted. The immediate cause of the fatal issue is believed by Pasteur and Joubert to consist in a removal of oxygen from the red corpuscles by the foreign organisms introduced into the system. This view was also adopted by Toussaint, whose more recent experiments, however, have led him to reconsider his original opinion (*Comptes Rendus*, December 3, 1877). Rabbits inoculated with blood freshly drawn from animals affected with splenic fever succumb to the disease in about twenty-four hours; the symptoms which precede death are those of gradual asphyxia, the animals dying comatose without convulsion. Neither artificial respiration nor a supply of highly-oxygenated air to the lungs avails to prevent or even to retard the fatal issue. Microscopic examination of the capillaries immediately after death shows a considerable proportion of them to be filled with rapidly growing bacilli; even the arterioles are occasionally seen to be obstructed. These changes are well marked in the capillaries of the omentum, the intestinal villi, and the brain. But their principal seat is in the lungs. When the chest is laid open the lungs do not entirely collapse; their surface is studded with emphysematous patches, and the bronchial tubes are filled with frothy mucus. The pulmonary capillaries are found to be stuffed with the specific organisms, the obstruction being perfectly adequate to explain an almost complete arrest of the circulation through the lungs. That such an arrest really does occur toward the close of the disease was proved by direct inspection of the thoracic organs before the heart had ceased to beat; its right cavities and the great veins were gorged with blood, while the left ventricle was almost empty. When an artery of considerable size was cut across, the amount of blood that flowed from it was insignificant. The right ventricle was seen to stop beating some time before its fellow. Accordingly, death must be ascribed to plugging of the pulmonary capillaries as its immediate cause. The process in question may be studied during life by keeping the epiploon under observation with high powers. The bacilli may be seen to accumulate in the capillary loops, and even to grow in length, checking the flow of blood through particular areas some time before the general circulation is stopped by death.

Antagonism between Atropia and Morphia.—It is commonly held, by practical physicians, that either of these alkaloids is capable of averting, or at any rate of delaying, death from an overdose of its fellow; that they are, in a clinical sense, antagonistic. The more exact methods of experimental pharmacology have not hitherto furnished many facts in support of this doctrine; indeed, the balance of evidence has been decidedly against it. Heubach has lately published some observations, however, which tend to corroborate the popular view (*Archiv für Pathol. und Pharmakol.*, viii., 1). His experiments were performed on the dog. In this animal large doses of morphia were found to cause gradual paralysis of the sensorium (narcosis), to diminish the activity of the respiratory center and the frequency of the heart's contractions, to lower the arterial blood-pressure and the temperature of the body. The hypodermic injection of relatively minute doses of atropia restored the dormant activity of the sensorium (in the majority of instances), rendered the shallow breathing deeper, accelerated the pulse and raised arterial tension, without, however, exerting any appreciable influence on the temperature. Further experiments showed that in the dog death from large doses of atropia might be prevented by the subsequent administration of morphia.

Termination of Nerve-fibers in Tactile Corpuscles.—Tactile organs of a very simple kind are present in the tongue and bill of the common duck, and the simplicity of their structure has enabled Ranvier to make out some new points about the mode in which nerve-fibers terminate, (*Comptes Rendus*, November 26, 1877). Each tactile corpuscle consists of two or more nucleated cells, regularly piled on one another. When there are only two cells, these are hemispherical in form with their plane surfaces in opposition. The nerve-fiber, on approaching the corpuscle, loses its sheath, which blends with the capsule; its axis-cylinder penetrates into the interior of the organ and expands into a circular disk (called by Ranvier the "tactile disk"), which lies between the opposed surfaces of the two cells and is completely overlapped and inclosed by them. Viewed under a low power, the tactile disk appears homogeneous; it is turned gray by osmic acid, violet by auric chloride; it is flexible and easily distorted by manipulation. Should the corpuscle consist of more than two cells, it contains more than one tactile disk, the number of the latter always bearing a constant ratio to that of the former. If a represent the number of cells, $a-1$ will be that of the disks. Having studied these very simple tactile corpuscles, Ranvier went on to compare them with those in the skin of the human finger, and arrived at the conclusion that the structure of the latter, though more complex, is fundamentally like that of the former.

On the Evidence of Metabolism in the Liver.—That the blood of the hepatic vein is richer in urea and sugar, poorer in fibrin, than portal blood, was regarded not very long ago as an ascertained fact, throwing much light on the intimate nature of the changes going on in the liver. The most recent researches, however, have shown that no quantitative difference as regards the three substances just named can be detected between hepatic and portal blood during life. Are we, therefore, justified in doubting the truth of our previous views of hepatic function? Some experiments lately carried out by Flügge furnish an answer to this question (*Zeitschrift für Biologie*, xiii., 2). He set out from the following considerations:—The liver undoubtedly secretes a considerable amount of bile, which flows into the intestine; the watery and saline constituents of the bile must be drawn from the blood passing through the gland; and these inorganic compounds admit of being estimated with far greater precision than the organic ones. Hence, if comparative analysis of hepatic and portal blood be capable of furnishing any information at all, it must show a decided diminution in the proportion of water and salts contained in the blood which has traversed the capillaries of the liver. A series of experiments was performed to settle this point, every precaution against accidental error having been taken. The result was altogether negative. No constant difference as regards water and inorganic salts could be shown to exist between the two kinds of blood, even when the digestive process was going on actively and bile flowing into the intestine. The same negative result was arrived at concerning hæmoglobin. Flügge then proceeds to show that our analytical methods are much too coarse to furnish the sort of information we demand from them. In our laboratory experiments we do not take time as an element in physiological processes sufficiently into account; the most imposing results of the activity of living tissues may be and often are wrought by the gradual summation of magnitudes too small to be measured; and the necessary failure of such analytical methods as that under consideration need not influence our judgment concerning the hepatic functions in any direction whatever.—*Academy.*

IMPROVED SURGERY ROOMS—MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

"*On the Construction of a Room or Series of Rooms free from Germ Life, proposed for use in the performance of Surgical Operations,*" illustrated by a Model Room and Apparatus.

By WILLIAM THOMSON, F. R. S. E.

MY object in bringing this paper before the society is to show what I consider to be a valuable application of a well-known principle, viz., that of filtering from the ordinary air the innumerable spores which are constantly found floating about in it, and so to arrange a room or series of rooms, in which the air may be rendered optically pure. The practicability of producing, and afterward retaining in a room or rooms of ordinary dimensions, an optically pure atmosphere, was suggested to me by the results of a large number of experiments which I have carried on during the last seven or eight years, but more especially the results obtained from a series of experiments, which I commenced about the beginning of this year, on the cultivation of different fungi, the spores of most of which are found in large numbers floating about in our atmosphere.

Flour paste suggested itself as the best soil I could obtain on which to grow the different fungi. When flour paste is exposed to the air for a few days, as is well known, fungus makes its appearance, and soon completely covers its surface, and if a number of flour pastes be made and exposed in different places, it will be found that different kinds of fungus spring up, in each showing a splendid variety of different colors, and shades of the same color. It was with a view to isolate and study these different fungi that one of my last series of experiments was commenced, and it became necessary to look for a means of sowing the seeds of each fungus on a soil which should originally be free from spore life, and afterward should be effectually protected from the falling of other spores from the air on to the soil, and further, should, if possible, give a free and open supply of air to the microscopic plants.

After a few experiments I found that this could be done effectually by placing flour paste in an ordinary glass shade turned upside down, covering the mouth of the shade with a thin layer of cotton-wool placed between two pieces of cloth, the three layers being fixed round the edges of the glass by an elastic band. The paste, when boiled in the vessel thus closed, was afterward found to remain free from fungus life for any length of time. Having thus been successful by such a rough arrangement in preventing the entrance of fungus spores, I next arranged to try the same experiment on a rougher and larger scale, and consequently had the rough model made which I show here this evening. Each side of this box or room is made of thin layers of cotton-wool sewn between two pieces of cloth, with a glass in front, which serves equally as door and window. A conical-shaped piece made of stout paper is pasted to a square frame at its base, which fits against one end of the room. An ordinary glass funnel is placed in this cone, with its stem passing through the apex, which is firmly tied round it, and an india-rubber tube communicating with a pair of bellows is put on the end of the stem; the large end of the funnel is covered with a thin layer of cotton-wool placed between two pieces of cloth, and the whole fixed round the funnel edge by means of an elastic band. When the window at the other end of the room is opened and the bellows worked, a current of air passes through a layer of cotton-wool placed between two pieces of cloth on the mouth of the funnel and then through that at the end of the room, moves bodily along the room and escapes at the window, little or no special currents or draughts being apparently produced. This I observe by previously filling the room with fumes. The force of the air, by passing through the two layers of cotton-wool, was evidently equally distributed throughout the whole area of the room. My first experiment with this arrangement was made by simply working the bellows for about twenty minutes to endeavor to drive the impure air, with its floating particles and spores, out of the room by passing into it the filtered air from the bellows; then boiling one half of some flour paste in a basin inside the room for a minute or two, and lastly closing the window with the glass, the other half of the paste being boiled in a similar basin and left outside exposed to the ordinary or contaminated air. After a few days the difference between the two pastes was very marked; the surface of the one left outside the room was completely covered with fungus, whereas only four or five little specks of fungus were observed to be growing on the surface of the one inside the house, which soon developed into 4 or 5 little buttons of fungus. I considered that the spores which had fallen on this flour paste must have been sticking to the sides or roof of the room, and to eliminate this assumed cause of error I drew out the supporting rods of the room and crushed it up and boiled it in water for half an hour, then allowed it to dry and repeated the same experiments with the two basins of flour paste, the bellows being first worked and the glass then taken out and laid down in the ordinary or contaminated air, then wiped with a clean cloth and put in. In a few days afterward the paste outside the house was completely covered with fungus, while the one inside was absolutely free from it, and it remained free for nearly a month, when one little speck was observed on it, which soon developed into a little button of fungus. This showed that for three weeks after the paste was placed in the room no spore had fallen on it. The only cause of failure I could see was the glass, upon which some spores must have adhered; consequently I had a bag made and sewn on above the window, into which the glass could be pulled in opening the window. When this was done the house was again crushed up and boiled in water, again placed in position, the paste boiled, the window closed, and in this third trial the experiment was perfect. No fungus was developed on the paste inside the house, and after some months it dried up to a hard mass. Thus these thin sheets of cotton-wool forming a room of 10,032 cubic inches capacity, *i. e.*, capable of holding 36 gallons of air, was sufficient to prevent the entrance of spores into it, and thus to preserve the flour paste from decomposition during several months, till it had completely dried up.

These results, I think, conclusively show that ordinary large rooms may be constructed and ventilated with filtered air by means of fans, so that flour paste, taken as a test standard, would remain in them free from fungus life, and I believe that such a room or series of rooms might be of great advantage in surgery, perhaps as a means of preventing spores from entering the wounds of patients, and so doing away with or lessening the onus put upon the antiseptic treatment, or in giving a better chance of success in serious surgical operations. It is, I understand, believed by many medical men that pus and blood poisoning may be generated in a wound from the blood corpuscles or bioplasts in the body, and that such developments have nothing to do with the germs of the outside air, and that the antiseptic treatment is employed to assist their development; but no one, so far as I know, has ever proved this beyond doubt, and such an arrangement of a room or rooms as I shall suggest further on would. I believe, be one mode of experimenting whereby the whole or a great part of a serious obstacle to such researches may be eliminated; but in passing I should like to mention one slight incident in reference to the development of pus in wounds which would tend to show that certain germs floating in the air are capable either directly or indirectly of developing pus. Some years ago, when working with a solution of albumen, which had been exposed to the air for some time, and which was then putrid, and swarming with bacteriæ, I accidentally cut my finger, and some of the putrid liquid entered the wound. I washed it out as well as possible, and thought nothing of it. Next morning it was slightly swollen, and had gathered. I opened it with a knife, and microscopically examined the matter, expecting to find bacteriæ, but to my surprise no bacteriæ could be observed, and all that could be seen was simply pus cells.

The arrangements which I should suggest on the large

scale are a long room or series of rooms in a line, at one end of which should be fitted a fan behind a good filter of cotton-wool, a long pipe with a series of Bunsen burners set along it, so that when all were lit a line or sheet of flame would be produced which might be gently passed along and made to play on every part of the floor, walls, and roof of the room, beginning near the end at which the fan works and going gradually toward the door; by this means any spores adhering to the walls would be destroyed, and no air could pass back to pollute the walls or floor which had been thus purified. A stove might be arranged at the door end of the room, by which cotton garments to cover the ordinary clothes of the surgeons and attendants might be heated to a temperature presumably sufficient to destroy or paralyze the vitality of any spores which might have been adhering to them, and where the knives and other appliances used might be previously heated, and where water used in washing the wounds might be previously heated under pressure. With such an arrangement at a hospital it seems to me that one interesting mode of investigation into some most important subjects might be commenced.

[NATURE.]

CHEMICAL NOTES.

Origin and Formation of Boracic Acid.—M. Dieulafait (*Comp. Rend.*, lxxxv., 605) finds that under certain conditions by spectrum analysis $\frac{1}{10000000}$ gramme of boron, and by the color imparted to a hydrogen flame $\frac{1}{1000000}$ gramme, may be detected. He considers boracic acid to be a normal constitutent of sea-water and salt marshes lying above beds of carnallite. M. Dieulafait finds that this acid may be recognized in a drop of sea-water weighing about 0·0378 gramme, and that the minimum quantity found in the Mediterranean is two decigrammes per cubic meter of water. He arrives by geological reasoning at conclusions differing from those of Dumas and others with regard to the origin of this body in the lagoons of Tuscany, and thinks that the source of boracic acid in this district may be found in a relatively modern formation.

The Action of certain Antiseptic Vapors on the Ripening of Fruits.—MM. Lechartier and Bellamy give an account in the *Comptes Rendus*, lxxxiv., 1035, of some experiments they made on the fermentation of apples when inclosed in vapors such as carbolic acid, camphor, and potassium cyanide. From their results it appears that no fermenting action took place in the apples surrounded by vapor of carbolic or hydrocyanic acids, and a slight action only in the one surrounded by camphor vapor. The camphor vapor, in fact, diminishes without entirely destroying the vitality of the cells. In this journal, also, there is an account of experiments performed in the same direction by M. Gayon. He incloses the apples in vapors of chloroform, ether and carbon disulphide, and his results agree with those of the first observers. The chloroform and ether act in the same manner as the carbolic and hydrocyanic acids; the carbon disulphide in the same way as camphor, permitting partial fermentation only.

A Problem in Chemical Affinity.—In his work on "Gasometric Methods," Prof. Bunsen details an interesting series of experiments on the phenomena accompanying the explosion of hydrogren and carbon monoxide with a volume of oxygen insufficient for its complete combustion. From the results he deduces the conclusion that the ratio between the products of combustion ($H_2O : CO_2$) can always be expressed by *small whole* numbers (1 : 2, 1 : 3, 1 : 4, &c.), and that it alters suddenly from one figure to the next by gradually increasing the amount of hydrogen. Deeming the nine experiments upon which the conclusion was based as insufficient for the establishment of a general principle, Prof. Horstmann, of Heidelberg, describes in the *Verhandlungen des heidelb. naturf. med. Vereins* an extensive series of observations designed to test the truth of the law. Among his results the following facts are of interest: In exploding CO with gradually increasing quantities of H_2+O, while the ratio between *H* and CO increased from 0·25 :1 to 2·33: 1, the ratio between H_2O and CO_2 gradually increased from 0·8: 1 to 4·5: 1, with no evidence of a predilection for rational numbers. Experiments on a mixture of CO and H, with gradually increasing amounts of O, led to the same results, showing no such regularity in the division of O between the two combustible gases as Bunsen's law would indicate. When aqueous vapor is present in the mixture, less H and more CO unites with O, while the presence of CO_2 reverses the case. By gradually increasing the amount of O in the explosive mixture, it was noticed that the ratio between the resultant H_2O and CO_2 increased until it attained a maximum, when 35 per cent. of the combustible gases were oxidized, and then sank regularly to the ratio denoting complete combustion. The oxygen appears to be divided among the two gases according to the following law:—The ratio between the resultant H_2O and CO_2 is equal to the ratio between the residual H and CO multiplied by a co-efficient of affinity which is independent of the ratio between the combustible gases but dependent on the relative quantity of O present. This co-efficient of affinity varied between 4 and 6·4, showing that always more H relatively than CO is consumed, and hence that the affinity of O to H is greater than that to CO.

Halogen Derivatives of Amines.—An attempt has frequently been made by chemists to replace the hydrogen in the hydrocarbon group present in amines, by Cl, Br, or I. These efforts have hitherto resulted simply in the substitution of the basic H atoms of the amine by halogens—as $C_3H_7.NCl_2$—or in complete decomposition. A. Michael (*Berl. Ber.*, x., 1644) has devised a method for accomplishing this end, which consists in first replacing these basic H atoms by acid residues, and then exposing to the action of a halogen ethyl-phthalimide,

$$C_6H_4(CO)_2N.C_2H_5,$$

yields in this way with Br a tribromo-ethyl-phthalimide.

Double Salts with Cyanide of Gold.—C. G. Lindbom publishes in the *Univ. Arsskrift* of Lund an exhaustive account of these compounds, which may be regarded as salts of the two acids, HCy.CyAu and HCy.CyAu.Cy_2+1½aq., neither of which, however, can be obtained pure for analysis on account of their tendency to decompose. Most of the auro salts unite directly with a molecule of the halogens; for example aurocyanide of sodium, $NaCy_2Au$, forms bromo-auricyanide of sodium, $NaCy_2AuBr_2$+2aq. Aurocyanide of ammonium, $AmCy_2Au$, is decomposed at 100°.

The Fourth Nitro-benzoic Acid.—Prof. F. Fittica has discovered lately a new nitro-benzoic acid, making the fourth of the isomeric acids, which has been contested by other chemists, especially as it fails altogether to harmonize with the theories at present accepted in regard to the structure of benzine derivatives. In the October session of the Deutsche Chemische Gesellschaft he strengthens his position by announcing the discovery of a fourth nitro-benzaldehyde, obtained by the action of H_2SO_4 on benzaldehyde and ethylic nitrate, which on oxidation is changed into the new nitro-benzoic acid, $C_6H_4NO_2COOH$.

Influence of Isomerism on the Formation of Ethers between Acids and Alcohols.—In the September session of the Russian Chemical Society, Prof. H. N. Menschutkin presented an elaborate paper on this subject based on observations of the formation of acetic ethers. The process consisted in inclosing molecular weights of an alcohol and acetic acid in glass tubes, immersing it in a glycerin bath at 154° for a certain time, and then rapidly cooling it, and titrating the unaffected acetic acid with baryta water. The results show that in regard to the rapidity and limits of etherification the primary alcohols are sharply divided from the secondary, and the latter from the tertiary, and the saturated alcohols from the non-saturated. A regular decrease in the rapidity coincides with an increase in the molecular weight of the alcohol. As in many other series of experiments, methylic alcohol shows considerable deviations from the laws governing its higher homologues. In the case of non-saturated alcohols the rapidity is less than that of the corresponding primary alcohols, but greater than that of the corresponding secondary alcohols.

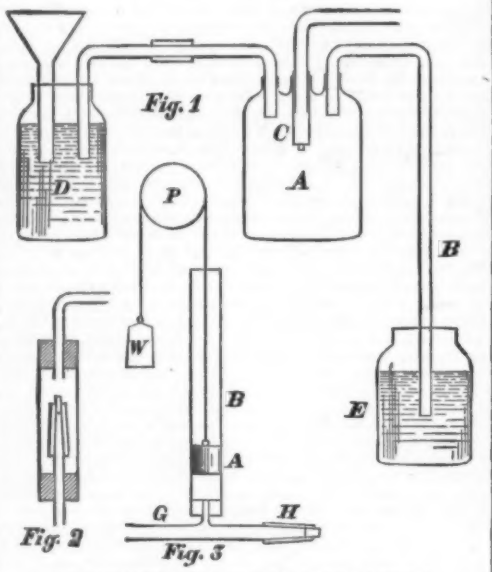
Phosphides of Tin.—Since the introduction of phosphorus bronze, the compounds of phosphorus and the metals are receiving more attention. S. Natanson and G. Vortmenn describe (*Berl. Ber.*, x., 1459) several methods of preparing phosphides of tin, viz., throwing P on molten tin, melting a mixture of vitreous phosphoric acid, charcoal and tin, and passing phosphorus vapors over molten tin in a hydrogen stream. These processes all yield a crystalline silvery white compound, containing from 1½ to 3 per cent. of P, and leaving on treatment with HKO a residue of pure SnP.

Chemical Action of Light.—In a late number of the *Annales de Chimie et Physique*, M. Chastaing advances, in connection with a variety of observations on this topic, the theory that the chemical action of the various colored rays on inorganic substances is dependent on refrangibility, blue and violet acting as reducing agents, red and yellow causing oxidation. Prof. H. W. Vogel attacks this opinion vigorously in the last session of the German Chemical Society, claiming that the nature of the substance causes the action to be one of reduction or oxidation. The union of H and Cl, which takes place so rapidly in violet light, is regarded as purely analogous to oxidation, and he alludes to Timiriazeff's late experiments, showing that the reduction of CO_2 by plants proceeds more rapidly in red light than in green.

APPARATUS FOR RAPID FILTERING.

I.

To one of the necks of the Wolff bottle, A, Fig. 1, is attached a glass tube, B, about ½ an inch in diameter, and from 3 to 6 feet long, dipping below in a jar, E, containing water. The middle neck carries a tube, C, which is an inverted Bunsen rubber valve (shown in Fig. 2), described in Thorpe's Quantitative Analysis, p. 62. The third tubulure connects the Wolff bottle with the flask D, which carries the funnel. A rubber connector between the two enables the operator to empty the filtrate, wash the precipitate,



APPARATUS FOR RAPID FILTRATION.

cleanse the flask D, etc. By suction, with the mouth at the tube C, a pressure of from 1 to 2 lbs. on the square inch may be obtained, as shown by the rise of the water in the tube B, and can easily be kept within certain limits.

II.

By the addition of the following, the pressure, as indicated by the water column D, Fig. 1 (or other suitable manometer), may be kept uniform. B, Fig. 3, is a glass tube at least an inch in diameter, to which is fitted a weighted solid plunger piston, A, more than counterbalanced by the weight W. The lower end of the tube B is connected to one of the arms of the "T" or "Y," G. Another of these arms terminates in a rubber valve, H (as above), opening outward, and the third arm is connected with the tube C, Fig. 1. When the weight W is lifted, the piston sinks, the air being driven out at H, and the subsequent rise of the piston creates a pressure which may be modified by the addition or subtraction of small weights from W. The valve C in Fig. 1 prevents the fall of the water-column, etc., when it is necessary to raise the weight W.

ROBT. C. HINDLEY.

Racine College, January, 1878.

PAINTS WITHOUT POISON.

By M. E. TURPIN.

A SOLUTION of the potassic or sodic eosin of commerce, treated with an acid, yields precipitate of eosic acid, insoluble in water. This precipitate, if washed until the water begins to turn rose-color, is insoluble in the hydrate of the oxide of zinc, and forms thus a very rich lake, which may vary from a rose to a deep red, according to the quantity of eosic acid employed. This acid, dissolved in a solution of sodic carbonate and precipitated with potash-alum, likewise gives a very rich lake. These lakes resist elevated temperatures and sulphurous emanations, and may be used in the coloration, in the mass, of vulcanized India-rubber, withstanding perfectly the degree of temperature required for vulcanization and the disengagement of sulphureted hydrogen which ensues during the reaction. The colors obtained with these lakes are in this case incomparably finer than the shades obtained with mercuric sulphide (vermillion) and antimonic sulphide, and may serve as substitutes for these colors in painting, and have the advantage of being harmless. Pure fluorescein likewise forms a yellow lake with hydrated zinc oxide. If eosin and fluoroscein are employed conjointly they yield lakes capable of replacing the reds and oranges obtained from lead, as minium, orange minium, etc. Zinc chromate, if treated with a potassic solution of eosin and the eosic acid liberated by the addition of alum, yields, on evaporation to dryness, lakes remarkable for the brightness of their shades, which may range from a pale yellow to a lively red, and which may serve as substitutes for the poisonous chromates of lead. These products, although attacked by water, may be advantageously employed in painting, for they are absolutely indecomposable by oils and essences, cover well, and can be prepared cheaply. With the aid of these new colors and certain others, the author has reproduced approximately, with non-poisonous colors, the chromatic table of M. Chevreul.

LIQUEFACTION OF NITROGEN, HYDROGEN AND ATMOSPHERIC AIR.

M. CAILLETET has communicated to the *Academie des Sciences* some further particulars on the liquefaction of gases, and at the meeting of the 31st of December a paper was read, from which we translate the following:

"*Nitrogen.*—Pure and dry nitrogen compressed to about 200 atmospheres, at a temperature of +13°, then allowed to expand suddenly, condenses in the most perfect manner; it first produces an appearance like that of a pulverized liquid in small drops of appreciable volume; this liquid then gradually disappears from the sides to the center of the tube, at last forming a sort of vertical column following the axis of the tube. The duration of these phenomena is about 3 seconds.

"These appearances leave no doubt as to the true character of the phenomena. I first tried the experiment at home at a temperature of —29°, and I repeated it yesterday, the 30th of December, several times at the laboratory of the Ecole Normale, in the presence of many *savants* and members of the Academy, among whom I am happy to name, with his assent, the venerable M. Boussingault.

"*Hydrogen.*—Hydrogen has always been considered the most incondensable gas, on account of its low density and the almost complete agreement of its mechanical properties with those of perfect gases. Thus it was only with great doubt as to the result that I decided to submit it to the same tests which had determined the liquefaction of all the other gases.

"In my first attempts I noticed nothing particular, but, as often happens in experimental science, skill in observing phenomena results in causing signs to be recognized under conditions where they had at first escaped notice.

"This is what occurred with hydrogen. On repeating my experiments to-day in the presence of MM. Berthelot, H. Sainte-Claire Deville and Mascart, who have allowed me to quote their testimony, I have succeeded in observing indications of the liquefaction of hydrogen under conditions of proof which have left no doubt on the minds of the scientific men who witnessed the experiment. It has been repeated a great number of times. Operating with pure hydrogen compressed to about 280 atmospheres, and then suddenly allowed to expand, we saw form an extremely attenuated and subtle mist suspended in the gas and disappearing suddenly. The production of this mist, in spite of its extreme subtlety, seemed incontestable to all the scientific men who witnessed the experiment to-day, and who took care to have it repeated several times, so as to leave no doubt as to its reality.

"*Air.*—Having liquefied nitrogen and oxygen, the liquefaction of air is thereby demonstrated. It appeared, however, of interest to make this the subject of an actual experiment, and, as might be expected, it succeeded perfectly. I need not say that the air was previously dried, and freed from carbonic acid. The accuracy of the views expressed by the founder of modern chemistry, Lavoisier, is thus confirmed as to the possibility of causing air to assume the liquid state, and of producing matter gifted with new and unknown properties—views recalled so appropriately at the last meeting by our illustrious perpetual secretary."—*Chemical News.*

REPRODUCTION OF THE SULPHIDE, SELENIDE, AND TELLURIDE OF SILVER IN A CRYSTALLINE STATE, AND OF FILIFORM SILVER.

By M. J. MARGATTET.

SILVER, gold, and occasionally copper are met with in nature in filaments, the appearance of which recalls that of a metal passed through a wire-drawing apparatus. These three metals may be artificially obtained by the dry way in this filiform condition on reducing their sulphides, selenides, and tellurides with hydrogen. The author obtains crystalline sulphide by passing the vapor of sulphur, carried slowly along by a current of hydrogen, over silver at a dull red heat. As soon as the sulphur comes in contact with the silver, the latter is covered with crystals of silver sulphide, which increase in size and number until the silver is completely sulphureted. The current of sulphur must be very slow. The composition and the physical properties of the artificial product are the same as those of the native sulphide, AgS. Its form is that of a rhomboidal dodecahedron. The selenide and telluride of silver are obtained in an analogous manner. The former is steel-gray and very brilliant, and crystallizes in the regular system in the form of a rhomboidal dodecahedron. Silver telluride is black, and is obtained in chaplets of regular octahedra, united by their summits. Crystalline silver sulphide is entirely converted into filiform metallic silver by a current of dry hydrogen at a tempera-

ture of 440°. Metallic silver appears at the outset of the operation in the form of small tufts implanted on the surface of the crystals of sulphide; as the reduction continues these tufts become threads, which increase in length and thickness at the expense of the silver continually set at liberty by the hydrogen. After some time they present the aspect of ribbons twisted in a spiral, mixed with small threads of extreme fineness, the whole supported by crystals of sulphide which have preserved their original form. The silver liberated presents no trace of a crystalline texture. The specimens thus obtained closely resemble the native associations of crystalline silver sulphide and of filiform silver so often met with. The selenide and telluride of silver yield also filiform metallic silver, but the reduction only sets in at a higher temperature.

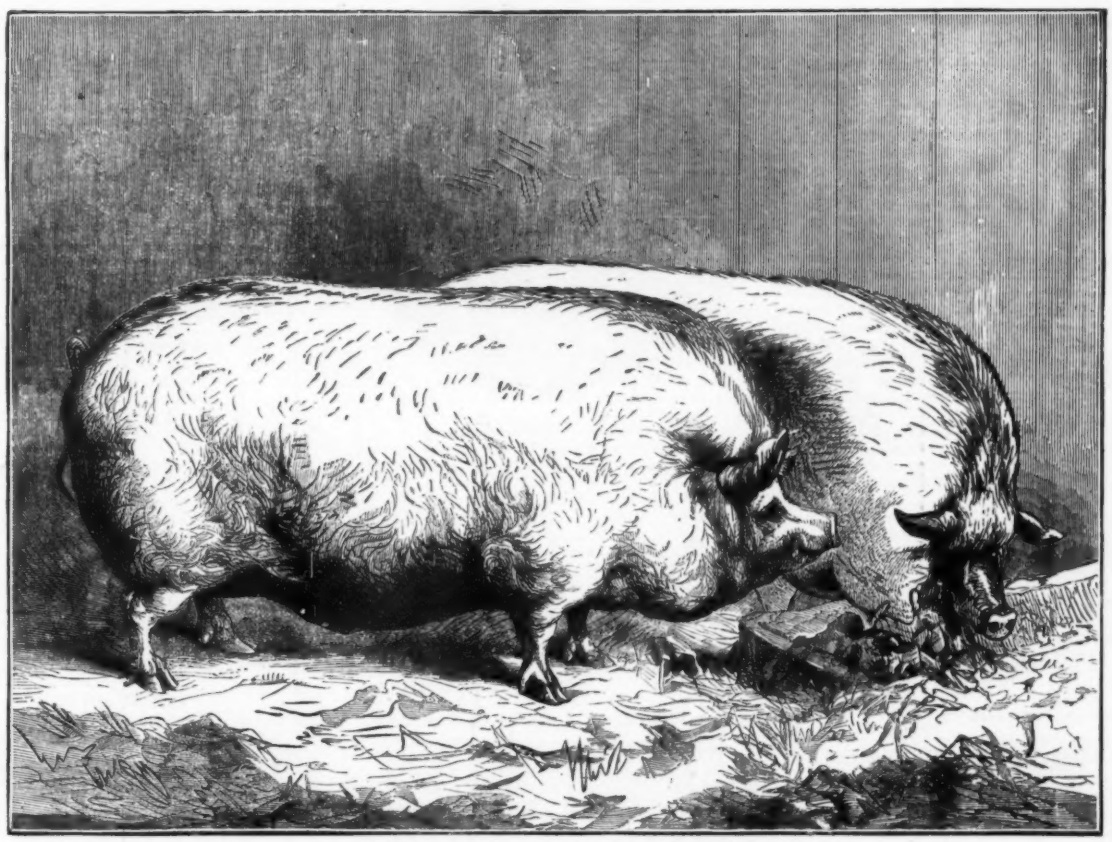
THE LARGE WHITE ENGLISH PIGS.

ENGLISH breeders generally admit that the large white varieties of swine are uncrossed with foreign blood, and hence are descended pretty directly from the old English pig. It is supposed that the "old English hog," with flop ears, was originally the only domestic animal of its kind throughout the kingdom. The genuine old English breed was coarse-boned, long in limb, narrow in the back, and low-shouldered; a form to which they were naturally inclined from the fact of having to travel far and labor hard for their food, as well as undergo considerable privations during the winter season. Surprising improvements resulted from better care, shelter and food, even where no fresh blood was introduced. Under improved conditions the thick flop ears became fine and thin, the bones a moderate size, bristles gave place to hair, and the white skin became fair and ruddy.

These animals are at present cultivated principally in the counties of Yorkshire, Lancashire, Lincolnshire and Leicestershire. At the earlier shows of the Royal Agricultural Society, from 1835 to 1850, enormous specimens of these white pigs, weighing 700 to 850, were exhibited. They were esteemed for the quality of the bacon, for their hardy and prolific character, the litter often reaching sixteen to eighteen, but they were incapable of early maturity and consumed a vast quantity of food. Those intended for bacon were kept in a store state until at least eighteen months old, and then at least twelve months' high feeding was necessary to produce anything remarkable, the cost of which far exceeded the market value of the pork. Of late years great improvement has been effected by careful selection and by more attention to feeding. Bakewell was the first to improve the Leicestershire pigs by discarding the longer, coarser animals, and selecting such as were more symmetrical and finer of bone. It is probable that the first step in the improvement of the Yorkshire pig was through the improved Leicestershire.

Naturally, the result of attention has been to develop an animal with more quality and greater tendency to early maturity. However, the width of the body, though much greater than of old, bears no proportion to the length, and fairly symmetrical as the matured animals are now found, they are decidedly flat-sided as compared with either the Berkshire, Essex or Suffolk breeds. The back is now level, the shoulders full and complete, yet the hind-quarter drops a good deal, while the bone is strong though perhaps not much in excess. The nature of the hair varies considerably. It is not unusual to find a decided want of coat, a serious drawback, since the unprotected skin is liable to crack. The best specimens have long and moderately fine hair, but never the curly profusion which adds such beauty to the small white sort.

Less prolific than in days of old, the large white varieties are still good breeders, and litters of twelve are not unusual. The females are good mothers and yield abundance of milk on suitable food, but the youngsters compare unfavorably with the admirable proportions of the smaller breeds. Early maturity is not looked for, though with age and good feeding they show their really grand proportions. Except for particular markets, large bacon, however excellent, is not as salable as medium or smaller sorts, consequently neither in England nor America is the demand for large breeds so good as formerly. While no doubt exists with respect to the great benefit that has arisen from diminishing the size and coarseness of the old breeds of swine, yet there is a proper limit to this diminution of size. It is not for the general good that all the large breeds should be merged into the smaller races. Rather than sacrifice them to the caprice of the markets, they should be improved by careful breeding and selection. For crossing with the smaller, more refined pigs, the large breeds are invaluable in producing grades of good size and quality, with aptitude to fatten, and frame sufficient to carry the desired flesh.—*Boston Cultivator.*



LARGE WHITE ENGLISH PIGS.

A VALUABLE FORAGE PLANT.

THE peculiarly valuable properties of the Caucasian prickly comfrey (*Symphytum asperrimum*) as a forage plant, its rapid growth in almost any climate, simple culture, and luxuriant yield, mark it out for general cultivation, and its importance to India and the colonies is such that we need offer no apology for noticing it. It is a perennial plant, easly propagated by cuttings, and being *deeply rooted*, is found to yield abundantly in the hottest seasons of a tropical climate when other vegetation is parched up and unproductive. Its prolificness exceeds that of any other green soiling plant. While good grass land yields but eight tons of grass to the acre cut green, lucerne 40, rye grass 50, and vetches 20, comfrey produces from 60 to 100 tons, and has been known (under exceptionally favorable conditions, of course) to give the enormous yield of 150 tons.

It comes in earlier than other crops and lasts longer, yielding a succession of cuttings. Above and around the root stems are shoots or suckers, called crowns, which may be taken off for planting, and the roots subdivided; these may be planted at all seasons of the year except in frosty weather.

Comfrey culture is simple and not costly; the ground is either forked or plowed six or eight inches deep, and well manured at the same time. The crowns or root cuttings are then planted like potato sets, 3 feet apart, say 1,200 to a quarter of an acre; during the first year a crop of mangold, turnip, or cabbage may be grown between the rows. It is, however, advisable, on the receipt of the sets, to place them on the ground in some warm sheltered situation, and arrange so that every 100 sets shall cover an area of two feet long by two feet broad; after so doing, cover the roots to a depth of two inches with rich garden loam soil, and afterward water them well; in a short time the sets will appear above ground, having thrown out a mass of white fibrous roots; in ten days or so the "sets" may be taken up and planted in the open ground. When the plant has grown to about the height of 1½ foot it ought to be cut over and used, as it is better not to allow it to grow too tall or to flower. In winter the roots ought to be well dressed with ordinary manure or sewage. When dried into hay it makes good fodder for the feeding and fattening of stock. The branches and leaves, made into bundles, keep well for forage in winter. The juice contains much gum and mucilage, but very little sugar. Cattle fed upon the plant are said to be free from the ravages of lung and foot and mouth diseases, and are strongly fortified against infection; its curative properties have long been known.

By the method of preserving green food in pits, known as *Ensilage*, comfrey may be stored with advantage for future use. The process may be described in a few words: As fast as the fodder falls into the stone-lined pits from the steam chaff-cutter it is spread out and firmly trodden by men. When the pit is full some salt is sprinkled on the uppermost layer; then comes a coating of long straw, and finally a covering of planks well weighed down with logs or stone—not earth, for it filters through to the fodder. For some time after the completion of the above work the pits need to be carefully examined every day, as, owing to the settling down of the fodder, cracks are apt to form in the roof, and these, if not closed, would admit a quantity of air, and injure the fodder by turning it mouldy. The same danger is incurred to some extent when a portion of the provender is taken out for feeding purposes, and on these occasions the precaution of covering over the exposed part again as quickly and completely as possible has to be observed. With regard to the cost of the above operations, as also of reaping, carrying, and cutting up, the total expense is estimated not to exceed 20 to 25 cents per ton. T. Christy & Co., of Fenchurch street, London, have introduced a solid stem variety of extra prolific growth.—*British Trade Journal.*

SANDALWOOD.

THIS wood, with the fragrant scent of which most of us are well acquainted, might be used in the manufacture of furniture to a much greater extent than it is, were it not that its price is enhanced by the Chinese burning it as incense before the shrines of their gods, and its use for similar purposes in India. But that it is applied to more useful purposes is shown from the fact that there is in Bombay a fair local demand for the manufacture of carved fancy boxes, etc., and wood for these purposes is also sent to Surat. Such boxes find their way to this country, where we are obliged, as a general rule, to put up with cedar if we wish for some sort of perfume in our furniture-wood. It is, indeed, difficult to procure sandalwood in sufficient quantity for any other purpose than inlaying. That the wood-carver could deal effectually with it is proved by the fact that in China much of this wood is used in the making-up of carved fancy articles. Although found in Australia, the Sandwich Islands, and other places, yet the best sandalwood grows in Mysore. From thence almost the whole of the export by sea goes to China and Arabia, small quantities only going by native craft up the coast. The wood is divided into five classes. The first three almost exclusively go to China; the hollow billets and the small broken pieces, which are not included in the five classes, going to Arabia, where they are either burned whole, for the sake of the fragrant smell arising therefrom, or ground up or powdered, and used with other ingredients as incense. Of that sent to Surat the inferior descriptions of billets are burned by the Parsees in their fire-temples, and are also used at Hindoo funerals when the friends of the deceased are able to afford it. For these purposes much wood is sent up the country by carts to various places in the presidency. The wood, rubbed down with water and worked into a paste, is used by all Hindoos in their caste marks, and is also employed as an external application for headaches and some skin diseases. A former conservator of the Mysore Forest relates that while in Bombay he came across two funeral processions, and in both instances he saw billets of sandalwood being carried along to be added to the piles on which the bodies were to be burned. While traveling to Surat by rail he met two Parsee priests, who got out at a small roadside station, and who had with them about half a maund of fifth-class wood. The trade in sandalwood at Mysore is almost entirely retail, and it supplies many of the surrounding villages, using about 50 or 60 tons per annum. The tree also grows at Surat, but it is said never to attain the size of the Mysore tree, and the wood is small, knotty, and decidedly inferior in fragrance to that of Mysore. All the Mysore sandalwood in the Bombay and Surat bazaars is called "Malabar sandal," and but few of the bazaar men know that the greater portion of the wood they sell comes from Mysore. Belfour, in his "Timber Trees of India," states that in 1847 nearly 1,000 tons of the true sandalwood, procured chiefly from New Caledonia, the New Hebrides, etc., were exported from Sydney to China, where it is burned with other incense in the temples. The sandalwood tree in these islands gives employment to about six small vessels, and the wood realizes about £30 per ton; but this must be vastly inferior to the Mysore wood, which is worth £76 10s. per ton.

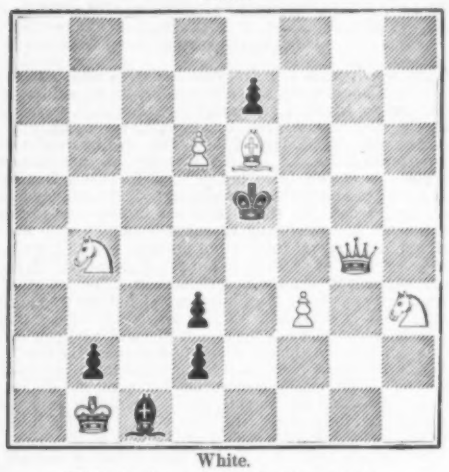
SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department may be addressed to SAMUEL LOYD, Elizabeth, N J.]

PROBLEM NO. 56. BY CHARLES A. GILBERG.

First Prize.—*Danbury News.*

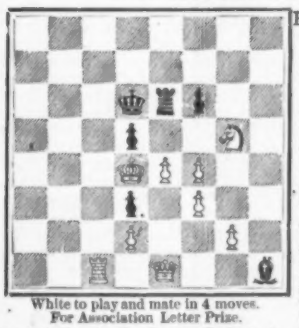
Black.



White.

White to play and mate in three moves.

F. M. TEED, OF NEW YORK.



White to play and mate in 4 moves.
For Association Letter Prize.

REFERENCE to the names of the contestants in the consultation match, an account of which is given in another column, will show that Mr Teed, whose youthful portrait we give this week, is recognized as one of the leading players of New York, who was selected to do battle with the giants in this interesting encounter. As a problemist Mr. Teed has long been considered one of our most gifted and careful composers, and has shown such a clear and correct conception of the beauties and intricacies of problem composing that he has become a most acceptable umpire in our problem tournaments, and has shown much good taste and sound judgment in his management of the problem department of Brownson's *Dubuque Chess Journal.*

Mr. Teed seems to have refrained from competing in problem tournaments, so we cannot give a selection of his victorious problems, but we would call especial attention to the following little gem as a fair specimen of his style of composition. We have never found a two-move problem that gave us more trouble to solve:

ENIGMA NO. 24.—BY F. M. TEED.

White.—K on K Kt 7, Q Q R 4, R K sq, B K B 5, Kts Q Kt 8 and K 8.

Black.—K K 2, Kts K 4 and 5.

White to play and mate in two moves.

THE HARTFORD TIMES LITERARY TOURNAMENT.

To encourage the literary department of chess, Mr. Beldon, of the Hartford *Times,* offered three prizes of twenty-five dollars in gold, each, for the best poem, story and essay upon the game of chess. The contributions having been published in the *Times,* the committee of award, consisting of Mrs. J. W. Gilbert, Chas. A. Gilberg and Augustus Blauvelt, have made the following award:

The prize for the best chess poem is awarded to Mrs. M. J. Hazeltine.

Mr. Joseph Wainwright receives the prize for the best story, and Mr. Alphonse Delannoy, of London, for the best essay.

The award has received the hearty indorsement of the editorial fraternity, and is, undoubtedly, a most fair and impartial decision. We congratulate the victor, however, that the masterly report of the umpires was not in competition.

M. LEGALLE.

THE Chancellor of France, d'Aguesseau, was very fond of chess, and used to play for half a crown a game with the best player of his time, M. Legalle. The latter once proposed deep play to the Chancellor, which he explained to be a living at Vincennes, that he wished to procure for an Abbé of his acquaintance. The Chancellor immediately took the move, and in pushing his pawn, said:

"Va l'Abbé."

Legalle soon got the advantage, but did not choose to win the game, but which, the Chancellor told him, should not prejudice his friend, and he accordingly gave him the benefice.

There is but one specimen of Legalle's skill which has come down to us (the following short game of seven moves):

LEGALLE.

WHITE.	BLACK.
1. P to K 4	1. P to K 4
2. K B to Q B 4	2. P to Q 3
3. K Kt to K B 3	3. Q Kt to Q B 3
4. Q Kt to Q B 3	4. Q B to K Kt 5
5. K Kt x K P	5. Q B x Q
6. B x K B P ch	6. K to K 2
7. Q Kt to Q 5 mate.	

which is the more remarkable as he was preceptor to Philidor and the first player of his day. A writer says of him:

"There is no man of whose person and deportment I retain a more vivid recollection. He was a thin, pale old gentleman, who had sat in the same seat at the cafe and worn the same green coat for a number of years, when I first visited Paris. While he played at chess, he took snuff in such profusion that his chitterling frill was literally saturated with stray particles of the powder; and he was, moreover, in the habit of enlivening the company during the progress of the game by a variety of remarks which everybody admired for their brilliancy."

GRAND CONSULTATION MATCH.

WE present to our readers the second game of the consultation match that has just terminated at the New York Café International for a prize of $100, offered by a liberal patron of the game. Capt. Mackenzie and allies won the match by a final score of three games, one game lost and one drawn.

F. M. TEED.

SECOND GAME (VIENNA OPENING).

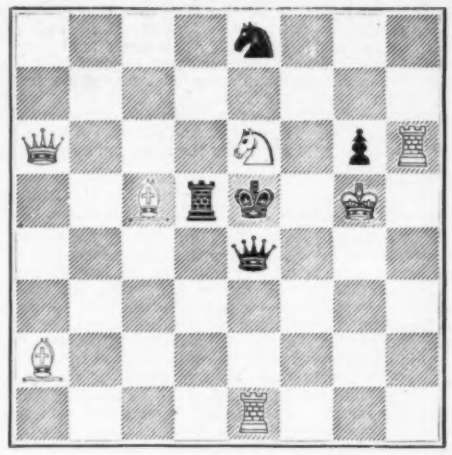
MESSRS. MASON, BRENZINGER AND DEVAUX.	MESSRS. MACKENZIE, TEED AND DELMAR.
WHITE.	BLACK.
1. P to K 4	1. P to K 4
2. Kt to Q B 3	2. B to B 4
3. P to K B 4	3. P to Q 3
4. Kt to K B 3	4. Kt to K B 3
5. B to Q B 4	5. Kt to Q B 3
6. P to Q 3	6. P to Q R 3
7. Q to K 2	7. B to K Kt 5
8. B to K 3	8. Kt to Q 5
9. B x Kt	9. B x B
10. P to K R 3	10. Q B x Kt
11. Q x B	11. P to Q B 3
12. P x P	12. P x P
13. Kt to K 2	13. P to Q Kt 4
14. Kt x B	14. Q x Kt
15. P to Q B 3	15. Q to Q 3
16. B to Kt 3	16. R to Q sq
17. Castles Q R	17. P to Q B 4
18. P to K Kt 4	18. Castles.
19. P to Kt 5	19. Kt to K sq
20. P to K R 4	20. Kt to Q B 2
21. P to R 5	21. Kt to K 3
22. K R to Kt sq (*a*)	22. K to R sq
23. B to B 2	23. P to Q Kt 5
24. P to K R 6	24. Kt to B 5
25. P x P ch	25. K x P
26. P x P	26. P x P
27. P to Q 4	27. P x P
28. Q R to K B sq	28. P to Q 6
29. Q x Kt	29. Q x Q ch
30. R x Q	30. R to Q B sq
31. R to K Kt 2	31. K R to K sq
32. R to Q 2	32. R x B ch
33. R x R	33. P x R
34. K x P	34. R to K 4
35. K to Kt 3	35. P to Q R 4
36. P to Q R 3	36. P x P
37. P x P	37. R x K Kt P
38. K to Q B 4	38. P to K R 4
39. K to Q 4	39. K to Kt 3
40. P to Q R 4	40. P to K B 3
41. R to K B 3	41. P to R 5
42. K to K 3	42. R to Kt 5
43. R to K B sq	43. P to R 6
44. K to B 3	44. K to Kt 4
45. R to K R sq	45. K to R 5
46. R to R 2	46. R to Kt 6
47. K to B 4	47. R to Kt 7
48. R to R sq	48. P to R 7, and wins.

(*a*) A remarkably weak move; P to K R 6, or P to K Kt 6, would have been the correct play. In justice to Mr. Mason we will state that consultation games are not his *forte,* and his play does not show to as great advantage as in match or tournament games. It would be well for the New Yorkers to prepare a team to try conclusions with the Philadelphians, who are now practicing in consultation games, and are so famous for encounters of this description.

PROBLEM NO. 57. BY CHARLES A. GILBERG.

First Prize.—*Danbury News.*

Black.



White.

White to play and mate in two moves.

SOLUTIONS TO PROBLEMS.

No. 50.—BY T. M. BROWN.

(Queen on K 7 being white.)

WHITE.	BLACK.
1. R to R 2	1. P to R 4 or K to B 6
2. Q to K sq	2. K to B 6 or P to R 4
3. B to Q 4 ch	3. K to B 5
4. Q x P ch	4. B or Q x Q mate.
	1 B to Kt 8
2. Kt to K 2	2. K to B 6
3. Kt x B ch	3. K to B 5
4. Q to Kt 5 ch	4. P x Q mate.

No. 51.—BY T. M. BROWN.

WHITE.	BLACK.
1. R to K 4	1. P to Q 6
2. B to Q 4	2. B x B
3. R to B 6	3. R x R
4. Q to Kt 4 ch	4. R x Q
5. B x P ch	5. B x B mate.

LETTER "H."—BY H. F. L. MEYER.

WHITE.	BLACK.
1. R to K Kt 7	1. K x P
2. K to Q 4	2. P to B 7
3. K x B	3. P x Kt
4. K x P	4. P to B 7
5. K to Q 6 dis. mate.	

THE game of chess as played by the ancients, though somewhat different in its regime from that of our day, was evidently of the same absorbing power of fascination. Tamerlane, the great Saracen conqueror, was a chess player, and during the terrible and decisive engagement in which Bajazet, the Turkish Emperor, was defeated and taken prisoner, he was intensely interested in a game which he finished just in time to find his forces everywhere victorious.—*Baltimore Dispatch.*

CHESS AT THE ANTIPODES.

A CHESS Club has been established at Patumahoe, a small settlement in the capital province of New Zealand, Auckland, forty miles in the bush; and although only five or six families at present form the population, fifteen members were enrolled and a tournament was decided to commence with. Perhaps a Staunton or a Morphy may yet come forth from this antipodean club to challenge their friends in England.—*Phila. Bulletin.*

THE DANBURY NEWS PROBLEM TOURNAMENT, NO. 1.

WE give this week the two problems by Mr. Chas. A. Gilberg, of Brooklyn, which carried off the honors of the recent Tournament of the *Danbury News.* Two prizes were offered, respectively, for the best two and three move problems, Capt. Mackenzie acted as umpire, and has shown good taste and sound judgment in his award, and the victor, as well as umpire and publishers, are to be congratulated upon a decision that will give general satisfaction. We have waited impatiently for a complete list of the competitors, and hope that it is not intended as a repetition of that exquisite sense of delicacy that induced the manager of the *Hartford Globe* Tourney to throw a mantle of charity over the names of the defeated competitors. We wish it to be distinctly understood that we all competed for both prizes in the *Danbury News;* did our level best and got whipped. Hurrah for Gilberg!!

The second Tournament is still progressing, and there is yet time for our competitors to join in the fun. The prize for the most brilliant game was won by Mr. G. Reichhelm, the Philadelphia champion, and editor of the chess department of the Philadelphia *Record,* which interesting publication has just made its reappearance in a greatly improved form.

We present this week the first letter problem received in competition for Dr. Moore's liberal addition to the Association prizes; we trust that our composers will bear in mind that this trophy is well worth striving for.

THE first chess column in the world was established in the *London Lancet,* in 1823. The first American chess department made its appearance in *The Spirit of the Times,* conducted by Charles H. Stanley, in March, 1845. The last, but not the least, has just appeared in the *Holyoke Transcript,* under the able management of our contributor, R. H. Seymour.